A PROSPECTIVE STUDY ON ANALYSIS OF FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF FIBULA BY CLOSED TENS NAILING IN ADDITION TO TIBIA IN DISTAL BOTH BONE LEG FRACTURES

DISSERTATION SUBMITTED FOR

MS (ORTHOPAEDICS)

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THE TAMIL NADU

DR. MGR MEDICAL UNIVERSITY

CHENNAI, TAMIL NADU

CERTIFICATE

This is to certify that the work "**A STUDY ON ANALYSIS OF FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF FIBULA BY CLOSED TENS NAILING IN ADDITION TO TIBIA IN DISTAL BOTH BONE LEG FRACTURES "** which is being submitted for M.S. Orthopaedics, is a bonafide work of **Dr.M.KISHORE KUMAR**, Post Graduate Student at Department of Orthopaedics, Madurai Medical College, Madurai.

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Madurai Medical college,

Madurai.

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CERTIFICATE

This is to certify that this dissertation "**A STUDY ON THE ANALYSIS OF FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF FIBULA BY CLOSED TENS NAILING IN ADDITION TO TIBIA IN DISTAL BOTH BONE LEG FRACTURES"**is the bonafide work done by Dr.M.KISHORE KUMAR under my direct guidance and supervision in the Department of Orthopaedic Surgery, Madurai Medical College, Madurai-20.

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DECLARATION

I, **Dr.M.KISHORE KUMAR**, solemnly declare that the dissertation titled“**A STUDY ON THE ANALYSIS OF FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF FIBULA BY CLOSED TENS NAILING IN ADDITION TO TIBIA IN DISTAL BOTH BONE LEG FRACTURES",** has been prepared by me. This is submitted to **“The Tamil Nadu Dr. M.G.R. Medical University, Chennai,** in partial fulfillment of the regulations for the award of M S degree branch II Orthopaedics.

DR.M.KISHORE KUMAR

PART A

- ACKNOWLEDGMENT

PART -B

ANNEXURES :

a. BIBLIOGRAPHY

b. PATIENT PRFORMA

c. CONSENT FORM

d. MASTER CHART

e. ETHICAL COMMITTEE APPROVAL

f. PLAGIARISM FIRST PAGE & DIGITAL RECEIPT

INTRODUCTION

Tibial Diaphyseal Fractures is one of the most common long bone fracture encountered[1,2].Distal third region accounts to about 20-30%[3,1,4,5]. Fractures in the distal third of Both Bones Leg when treated by conservative line of management,there are high chances of malunions[1,2], ankle stiffness due to prolonged immobilization, delayed union, valgus or varus mal-alignment of tibia.

Schoot et al[6] (1996) followed up 88 patients with fracture of distal third of leg with attention to angular deformity, osteoarthritis of the knee, ankle and any other residual complaints. They showed positive relation between degeneration[7] process in knee and ankle with mal-alignment of tibia[8,9,10]. They opined that fractures of distal third of leg should be managed so that the possibility of angular deformity should be minimized and thereby minimize late arthritis.

Intramedullary Interlocking Nailing appears to be one of the good treatment options available because of various advantages like less wound complications, less malunion, early weight-bearing and early motion.

Anatomical reduction seems to be needed to reduce malaligned tibia which result in ankle & knee arthritis . As the deformity approaches either of the joints, mal-alignment leads to mal-distribution of articular surface pressures, that may predispose to premature osteoarthritis[15].

To study the clinical relevance of fibular fixation by closed tens nailing in addition to tibia in distal third fractures of both bones of leg and in an effort to outline the advantage and benefits of fixation of the fibula, this study was undertaken.

AIM OF THE STUDY

- **To Analyse and Evaluate "FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF FIBULA BY CLOSED TENS NAILING IN ADDITION TO TIBIA IN DISTAL BOTH BONE LEG FRACTURES"**

OBJECTIVES :

1) Assessment of tibial mal-alignment in distal both bone leg fractures patients treated with fixation of fibula by closed tens nailing in addition to tibia fixed with intramedullary interlocking nail.

2) To assess the time of union of tibia.

3) To assess the functional outcome of fracture fixation in these patients.

REVIEW OF LITERATURE

The various methods of treatment of fractures of the both bones of the leg and its complications have been the material of study for various authors :

Robinson et al[21] in 1995 has observed that in his study of tibial diaphyseal fractures treatment by intramedullary nailing appears to be good and safe modality of treatment for diaphyseal tibial fractures.

Sarmiento et al[23] (1995) has reported in his study of 1000 patients by closed reduction & casting that intact fibula has both advantages & disadvantages such as intact fibula increases tibia union rate but has lead to increased rotational stability.

Puno et al[27] (1986) in his study compared nailing & casting for tibial fractures,has found nailing group had decreased malalignment.

Teitz et al[28]in 1980 studied the problems associated with tibial fractures with intact fibula and biomechanical studies[29]were done on experimental models. It was suggestedthat whenever the fibula remains intact, a tibiofibular length discrepancy develops and causes

altered strain patterns in the tibia and fibula. These can lead to delayed union, non-union or varus mal-union of the tibia with the sequelae of ankle osteo-arthrosis.

Takebe et al[30] (1983)did experiments on autopsy specimens to analyse the weight bearing function of fibula. They cited that weight distribution to the fibula was 6.4% with the ankle joint in neutral position. With dorsiflexion of the ankle joint the weight on the fibula increased and with plantar flexion, the weight on the fibula decreased.

Goh et al[31] (1992)analysed load bearing characteristics of the fibula in different ankle positions before and after resection of the proximal fibula in experimental models. It was founded that the load transmission through the fibula varied with different ankle positions. With the ankle at neutral position, the load distribution to the fibula averaged 7.12% of the total force transmitted through the tibia and fibula.

In Journal of Orthopaedic Trauma:[33] January 2009 ; Vol. 1, no. 1, 33-40(2009)

It concludes that of the in distal third both bone leg fractures treatment by fixation of fibula and tibia had lead to increased stability of the ankle and decreased malallignment of tibia.

Journal Of Orthopaedics&Traumatology*[43] *: Surgery and Research (2010) 96, 674-682 ;' In laboratory simulation, fibular fixation initially increased stability by decreasing initial rotational displacement in nailed distal third tibial fractures. These data support our clinical observations that fibular fixation may decrease late valgus malalignment in distal third comminuted tibial fractures with a fibular fracture at the same level'.

Int J Clin Exp Med 2015;8(6):10086-10090.www.ijcem.com /ISSN:1940-5901/IJCEM0008592

Treatment of adult tibiofibular fractures, especially severely comminuted fractures, is technically challenging due to the lack of reduction markers and difficulty in restoring the alignment. Fixation of the fibula can facilitate reduction of the tibia fracture and restoration of the lower-extremity alignment.

FUNCTIONAL ANATOMY

An in depth knowledge of both topographical as well structural anatomy of leg is essential to plan operative procedures in the lower extremity. The distal part of leg from knee to the ankle plays a major role in the structure and function of these important joints.

The anteromedial surface of the tibia and anterior crest are easily palpated from the area of tibial tuberosity and distally in to its termination in the medial malleolus. The tibia, with its asymmetric[35] surrounding soft tissues, determines the shape of the lower part of the leg. Tibia has got a roughly triangular external cross section which has an anteriorly directed apex. The fibular shaft is palpable at the proximal portion of the fibular head and then is covered by the peroneal muscles until the distal third, where the lateral fibular shaft can be palpated to its termination in the lateral malleolus.

The adult tibia ranges widely from around 26 cm even up to48 cm in length. The minimal diameter of the medullary canal of the tibia ranges from less than 8 mm to more than 15 mm. Length and internal diameter have significant implications for the size of the implants required for intramedullary fixation.

At the metaphyseal-diaphyseal transitions proximally and distally, the cortex thins and the medullary canal expands. Clinically this frequently presents difficulties, when intramedullary or external fixation is required for fractures in the proximal and distal fourth. In these regions, intramedullary nails do not fill the canal and thus offer little or no resistance to deformity forces without interlocking screw supplementation

Most of the tibia is diaphyseal. Its enlarged proximal and distal ends are composed of cancellous bone, which varies in density according to both location and the individual's age. The diaphyseal portion is marked by a very dense anterior tibial crest running proximally from the tibial tuberosity to just above the ankle. The medullary canal of the tibia is more triangular in cross section than circular. The lack of curvature of tibialmedullary canal as opposed to the femur makes a longitudinal interference fit with an intramedullary nail difficult. .

The anteromedial subcutaneous surface of the tibia has no muscular or ligamentous attachments[35] from the pes-anserinus tendons and tibial collateral ligament of knee to the deltoid ligament of the ankle. This readily palpable surface is concave medially as it approaches the medial malleolus. Its anterolateral surface forms the

medial wall of the anterior muscular compartment of the leg, with the tibialis anterior and more distally, the neurovascular bundle and extensor hallucis longus muscle adjacent to it.

The posterior surface of tibia, buried under superficial and deep muscle compartments, has attachments in a proximal to distal direction, for the semimembranosus, popliteus, soleus, tibialis posterior and flexor digitorum longus muscles. The posterior tibial vessels[26], the tibial nerve, and the flexor hallucis longus muscle approach it distally by curving around the medial malleolus behind the tibialis posterior and flexor digitorum longus. The proximal tibial metaphysis, with its medial and lateral tibial plateaus, is much larger in diameter than the shaft but is similarly triangular in cross section. Laterally, it overhangs the interosseous membrane and articulates postero-laterally with the head of the fibula. The apex anterior angulation of the proximal end of the tibia averages 15^{o}. The backward sloping, but variably shaped anterior surface of the tibial metaphysis offers a more or less obvious surface for inserting an intramedullary nail. The cancellous bone of the proximal metaphysis can be perforated fairly easily to gain access to the medullary canal. However, the shape of the proximal end of the tibia, its posterior overhang and its thin, flat posterior wall make it possible to err and perforate the posterior cortex.

The medullary canal becomes distinctly tubular 5 or 10 cm distal to the tibial tubercle and has thick walls, especially anteriorly, where the prominent crest of the tibia occupies nearly a third of the diameter of the entire bone.

Distally the cortex thins and the fatty medullary contents are replaced with cancellous bone that is dense. This cancellous bone provides secure purchase for screws and is often compact enough to resist penetration by an intramedullary nail.

The contour of the distal end of the tibia has a pronounced concavity on its anteromedial surface. As the triangular diaphyseal cross section rounds gently in to the pilon or distal tibial metaphysis, the anteromedial surface, oriented about 45^{o} to the sagittal plane, turns medially so that it's most distal extent lies nearly in a sagittal plane.

The medullary canal of tibia extends from the cancellous bone of the proximal metaphysis to that of the distal metaphysis. If the canal were extended proximally along its axis, it would enter the lateral plateau because of the relatively greater medial overhang. The largest sagittal dimension of the proximal end of the tibia is also laterally located. The diaphyseal canal is significantly more round in

cross section than external appearance of the tibia would suggest. The diaphyseal canal is more hourglass shaped.

Even after intramedullary reaming, a snug fit for an intramedullary nail can be obtained only around the isthmus. This limitation adversely affects the stability of proximal and distal fractures fixed with a nail. In the young, the medullary canal tends to be narrow. With aging and osteoporosis, the cortex becomes thinner, the metaphyseal cancellous bone becomes less dense, and the internal diameter of the medullary canal increases.

Figure 1.Superior View of Proximal Tibial and Fibular Anatomy[36]

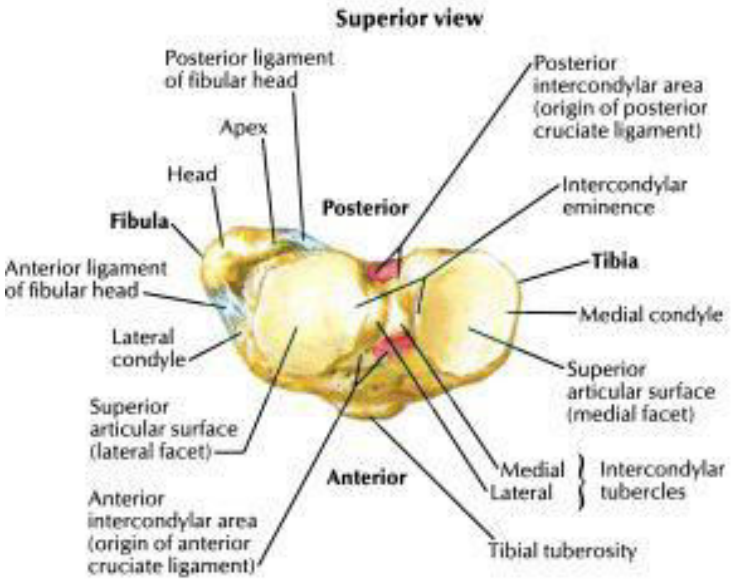


Figure 2. Cross Section View of Tibia and Fibula with Interosseous Membrane

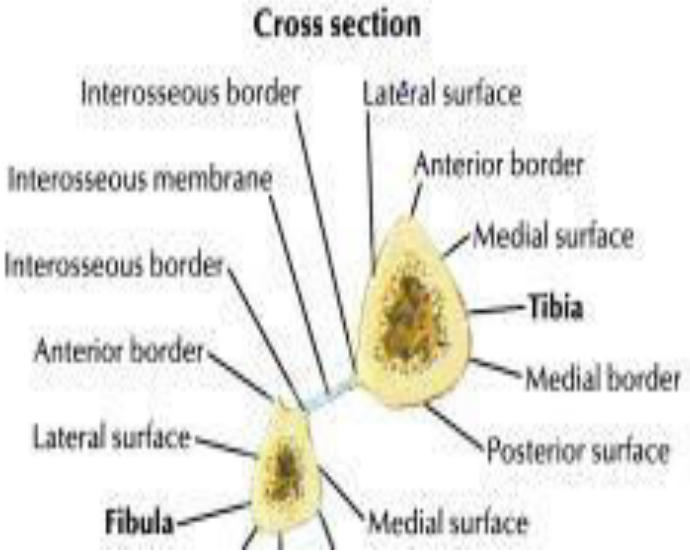
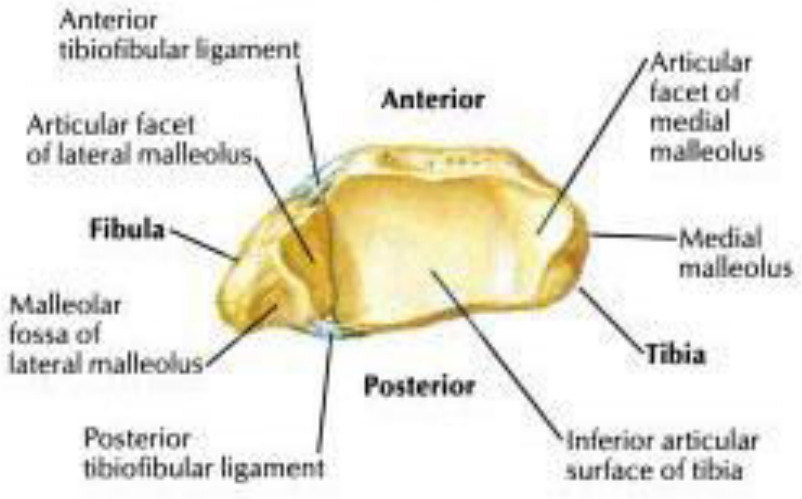


Figure 3. Inferior View of Distal Tibial and Fibular Anatomy[36]



The fibula is situated posterolateral to tibia. The fibula is further from the tibia in the proximal half of the leg and approaches it closely in the distal half until it lies within a shallow articular facet on the posterolateral surface of the distal tibial metaphysis. Securely attached to each other, the tibia and fibula, articulate proximally at the superior tibiofibular joint and distally at the inferior tibio-fibular joint.

Although fibula does bear a small portion of body weight, its function is only slightly affected by absence of its diaphysis or proximal extent. Removal of a portion of the fibula decreases[30,31,37], but does not abolish tension strain on tibia's anterior surface.

The distal third of the fibula has a major role in the structural integrity of the ankle joint. It is securely attached to the distal end of tibia through the ligaments of the anklesyndesmosis- the anterior and posterior distal tibiofibular ligaments, the inferior transverse ligament, and the interosseous ligament – as well as through the distal interosseous membrane. Disruption of these ligaments[19,38], with resultant loss of fibular support for the talus, may occur in association with tibial shaft fractures. Therefore the integrity of the ankle joint should always be assessed in patients with tibial fractures.

A thick interosseous membrane connects the lateral crest of the tibia to the anteromedial border of the fibula. Its major fibers run downward and laterally. This membrane is often largely intact after indirect torsional fractures of the tibia.

Over the top of the interosseous membrane beneath the proximal tibiofibular joint, the anterior tibial artery and its accompanying veins enter the anterior compartment of the leg. Injury to these structures may be associated with proximal tibial fractures and tibiofibular joint dislocations. The terminal peroneal artery passes anteriorly under the distal edge of the interosseous membrane to join the vascular anastomosis about the ankle.

The skin over the leg receives significant blood supply from the underlying fascia by way of small perforating arteries. These arteries are disrupted by subcutaneous dissection that separate the subcutaneous fat from the underlying fascia. Therefore dissection should proceed beneath, rather than superficial to the deep fascia to decrease the risk of skin necrosis and take advantage of the sub-fascial arterial plexus. The dermal plexus is the terminal vascular bed of the skin.

Superficial veins in the subcutaneous tissue of the leg include the great saphenous on the medial side and the short saphenous on the lateral side. The saphenous nerve branches run with the great saphenous vein on the medial side and the sural nerve runs with the short saphenous vein on the lateral side.

Compartmental Anatomy of the Leg:

The musculature of the leg is divided into four compartments.

The deep fascia of the leg envelope it circumferentially and is adherent to the tibia along its anteromedial surface, as well as proximally and distally. The cylinder thus formed is subdivided in to four well defined longitudinal compartments by septa that attach along the fibula.

The postero-lateral septum lies between the lateral and superficial posterior compartments.

The Anterior compartment:

It contains;

Tibialis anterior, Extensor digitorumlongus, Extensor hallucis longus, Peronius tertius, Anteriortibial artery and vein and Deep peroneal nerve

The anterior compartment muscles are the main dorsiflexors of the ankle.The anterior compartment structures are dissected off the tibial surface and retracted laterally during an anterolateral surgical approach to the tibia, this being required for plate osteosynthesis.

The Lateral compartment:

Contents of lateral compartment are;

1. Peroneus longus, Peroneus brevis, Superficial peroneal nerve.

They are the main evertors of the foot.. The superficial peroneal nerve has high chances of injury during lateral fasciotomy& fibular plate fixation techniques.

The superficial posterior compartment:

The contents are;

Gastrocnemius, Soleus, Plantaris, Saphenous and Sural nerve, Short and long saphenous veins.

They are the primary plantar flexors of the ankle.

The Deep posterior compartment :

The contents are; Tibialis posterior, Flexor digitorum longus, Flexor hallucis longus, Posterior tibial nerve, Posterior tibial artery and vein, Peroneal artery and vein.

The posterior deep compartment can be difficult to assess for compartment syndrome by clinical examination and it is the compartment most often incompletely released during fasciotomy.

Figure 4 :Fascial Compartment of the Leg

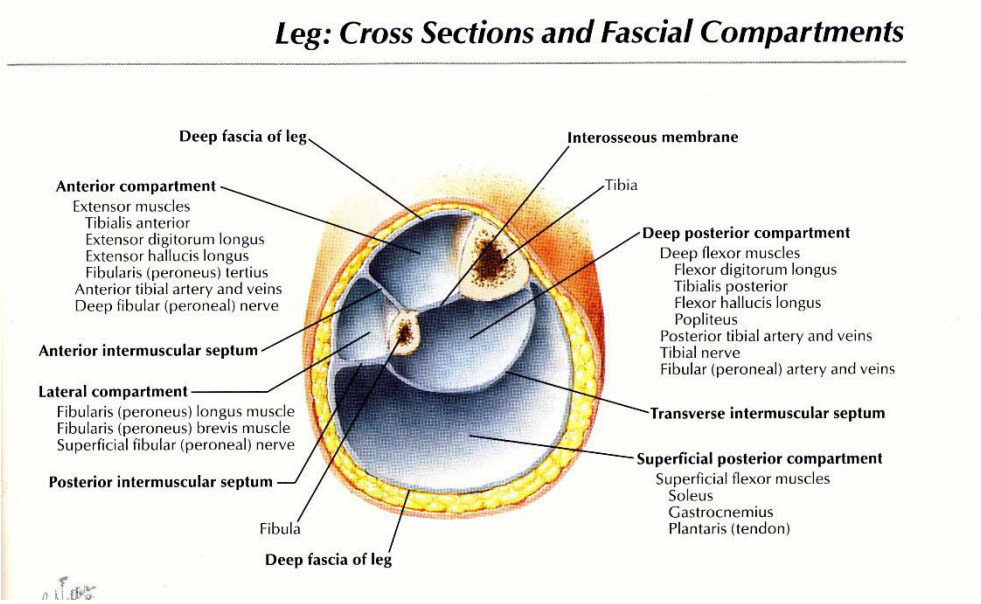


Figure 5 : Cross-sectional anatomy of the leg[36]

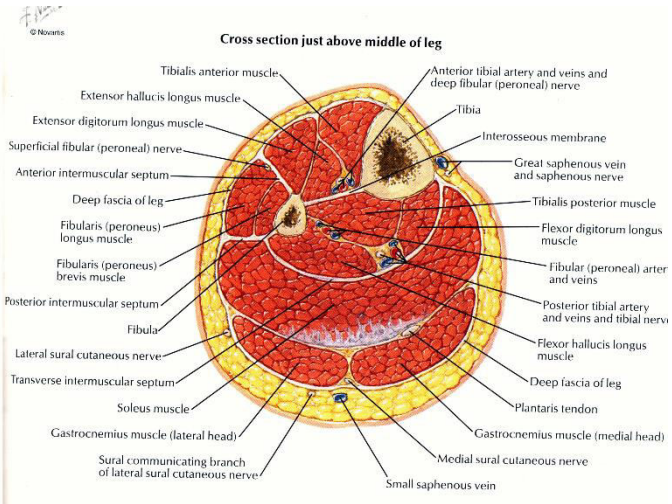
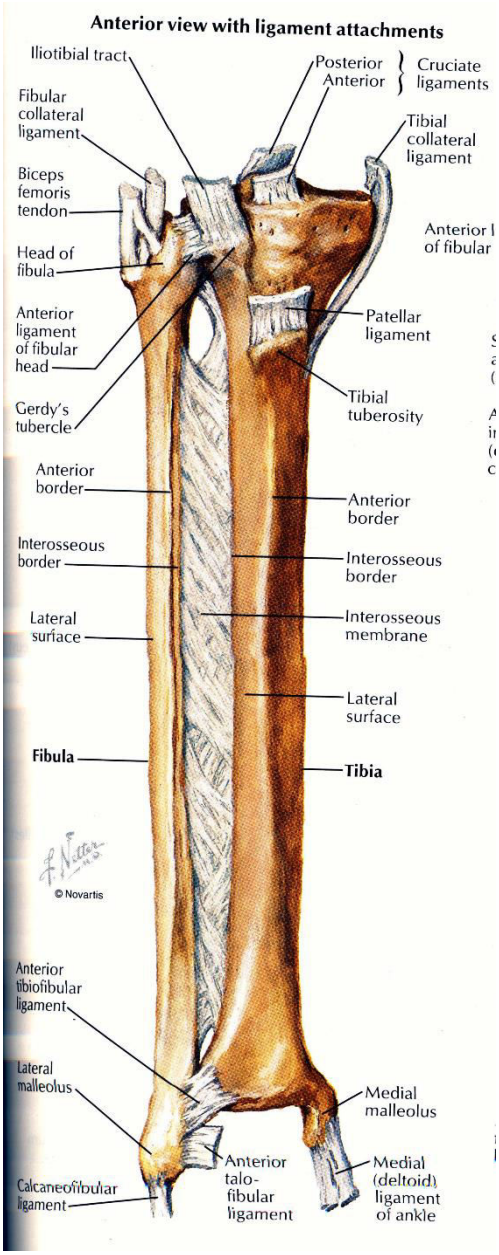


Figure 6 : Tibia and Fibula with Ligament Attachments[36]



MECHANISM OF INJURY:

Mechanisms of injury leading to lower limb both bones leg fracture range from trivial falls in osteoporotic individuals even up to high energy direct crush injuries .

Direct injuries: mechanism[1] includes bending, direct application of force resulting in a greater amount of direct soft tissue injury. A direct force injury can be suspected right from the history elicited from the patient, soft tissue status of the limb and in x-ray pattern of fracture (comminuted fractures, a butterfly fragment wedging in the compression side and transverse pattern in the tension side of the fracture).

Indirect Injuries[1] :They are usually caused by a twisting force that acts from adistance leading on to a spiral pattern of fracture with very minimal soft tissue injury.

The various mode of injury leading to tibial fracture are,

1. Torsional injuries[3] **(eg: Skiing injuries)** are common with low energy trauma where the foot becomes fixed and the body rotates about this fixed point. Radio-graphically these injuries are spiral with varying degrees of comminution.

2. Direct force[3] – result in crushing injuries with increased damage to bone and soft tissues. The exposed, subcutaneous location of the tibia offers little protection from a direct blow. Fractures of the tibia are most common in frequency after the fractures of the ribs, face and head.

ASSOCIATED INJURIES:

The most common injury[42] associated with tibial fracture is the same side fibular fracture. Injuries to fibula occur in about 80% of these patients.Fibula fracture can occur at the same level of the tibial fracture or may be at a higher level and sometimes segmental too.

The ligamentous supports of the knee may also be injured in cases of high energy diaphyseal fractures of tibia. Fracture dislocations[39] of the knee joint may also be an associated finding.These injuries, especially the posterior dislocation of knee has a very strong association with vascular and nerve injuries. Sometimes if it is a high energy violence there is high chance for injury to the ipsilateral femur, which is commonly referred to as floating knee injury.

CLASSIFICATION

Various systems of classification have been proposed for tibialdiaphyseal fractures. The morphological variables essential for this include:

1. Location of the fracture
2. Fracture Morphology
3. Association of fibular injuries
4. Soft tissue status
5. Position of the fractured fragments.

Classification systems described are :

1) JOHNER AND WRUCHS CLASSIFICATION[40] :

(Modification of American Society of Internal Fixation (ASIF) classification, as developed by Muller et al) Based on fracture pattern, typical cause and mechanism of injury.

Table 1

	A-simple			**B-Butterfly**			**C-comminuted**		
Fract-ure patt-ern	A_1 spiral	A_2 obliq ue	A_3 Trans-verse	B_1 Butter-fly by torsion	B_2 Butter fly by one bending	B_3 Butter fly by several bending	C_1 By torsion	C_2 segment al fracture	C_3 crush
Typi-cal cause	Slipping skiing	Motor cycle, Car crash	Soccer, motor cycle	Skiing	Car bumper	Car bumper	High speed skiing	Car bumper	Industry war
Mecha -nism	Torsion	Unev en bendi ng	Pure bending	Torsion + bending	Bending + compression	Bending + compre-ssion	High speed torsion	Four point bending	Crush

2) HENLEY'S MODIFICATION OF WINQUIST AND HANSEN CLASSIFICATION FOR DIAPHYSEAL FRACTURES OF TIBIA

Table 2

Type I	Comminution with a small butterfly fragment i.e. <25% of width of bone
TypeII	Comminution with a butterfly fragment of up to 50% of the width of the bone
Type III	Comminution with a large butterfly segment, greater than 50% of the width of the bone
Type IV	Comminution of a complete bone segment and denotes lack of inherent rotational and axial stability
Type V	With a segmental bone loss

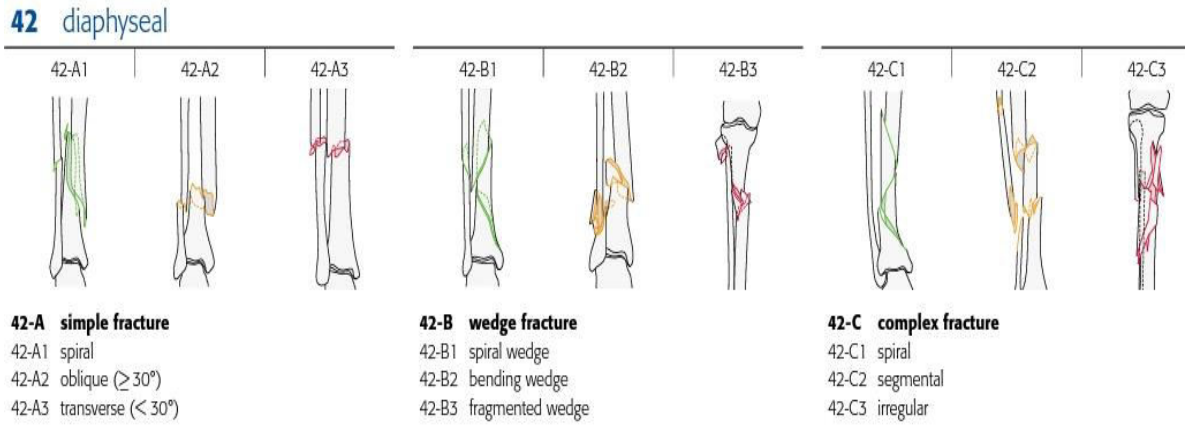
3) GUSTILO AND ANDERSON'S CLASSIFICATIONS OF OPEN FRACTURES :

Table 3

Type I	Clean wound of less than 1 cm in length
Type II	Wound larger than 1 cm in length without extensive soft tissue damage
Type III	Wound associated with extensive soft tissue damage; usually longer than 5 cm .Open segmental fracture .Traumatic amputation Gunshot injuries,Farmyard injuries .Fractures associated with vascular repair
Type IIIA	Adequate periosteal cover

Type IIIB	Presence of significant periosteal stripping
Type IIIC	Vascular injury requiring repair

4) ORTHOPAEDIC TRAUMA ASSOCIATION(OTA) CLASSIFICATION OF TIBIAL DIAPHYSEAL FRACTURES :



TREATMENT :

1. TREATMENTGOALS:

• To maintain the alignment. In nearly all patients, as much as 1 cm of shortening and 5 ^{o} or less of angular deformity or mal-rotation is not significant.

• Restoring structural stability and maintaining an acceptable mechanical axis for tibial diaphysis.

• To achieve complete union in a reasonable period of time without complications.

• Restoring limb function with good ankle, subtalar joint and knee motion with Muscle strength comparable to normal.

2. METHODS OF TREATMENT :

Four distinct modalities of treatment have evolved for treatment of fractures of tibia and fibula :

(1) Closed reduction and immobilization with a brace or plaster cast

(2) Open reduction with internal fixation

(3) External fixators

(4) Intramedullary interlocking nailing.

A. NON-OPERATIVE IMMOBILIZATION:

i) Cast immobilization:-

- Weight bearing or non-weight bearing.
- Long-leg, short-leg

ii) Cast brace :-

- short or long-leg
- Custom or prefabricated.

iii) Traction.

B. OPERATIVE FIXATION :

i) External fixation :-

- pins and plaster cast
- full pin fixation (Hoffmann technique)
- circular fixation with tensioned wires
- hybrid external fixation system

ii) Plate and screw fixation:-

- screws alone
- rigid plate fixation with compression
- Minimal contact plates.

iii) Intramedullary nailing[24]:-

- flexible nails.
- Non-locking nails.
- Locking nails, reamed or un-reamed

iv) Combination of the above

v) Sequential use of the above.

INTRAMEDULLARY NAILING :

Intramedullary nailing is the favoured fixation technique[41] for diaphyseal fractures of the tibia. IMIL Nails are grouped into reamed and non-reamed ones depending on whether fracture is open or closed[33]. Unreamed nails are usually preferred for open fractures where the periosteal healing and blood supply is already lost.

Reamed nails usually have larger diameters (around10mm) compared to unreamed nails which are relatively smaller ones. The IMIL nails have

interlocking holes in different planes both in proximal as well as distal ends.

Reamed intramedullary nails usually have a uniform contact with the inner surface of the medullary canal thereby controlling diaphyseal fractures. With locking bolts applied in proximal and distal holes medio-lateral, antero-posterior and rotational stability are provided.

Figure 7. Approach for Intramedullary Nailing[41]

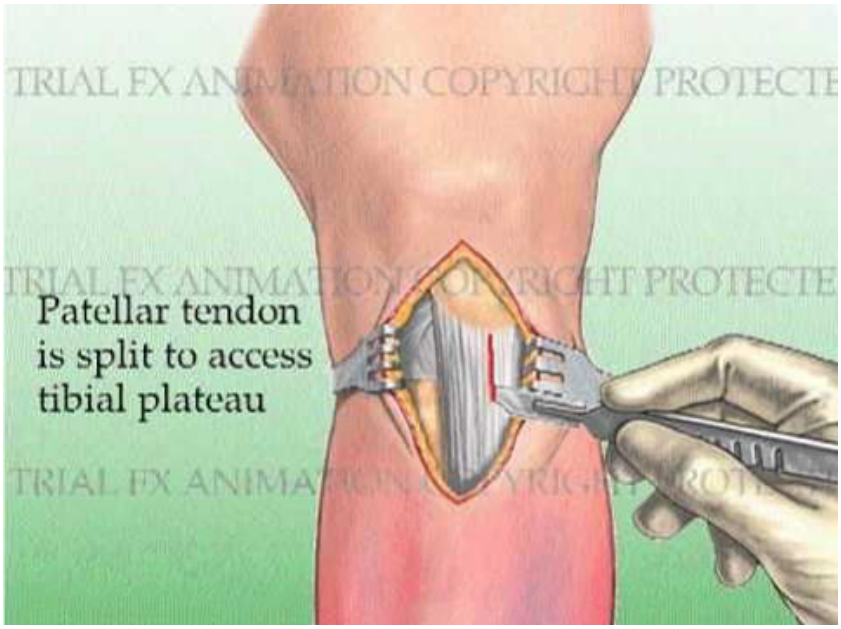
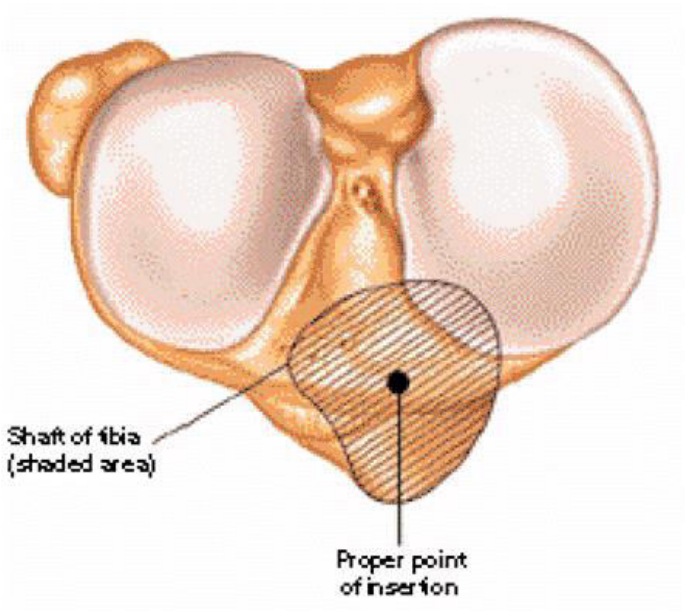


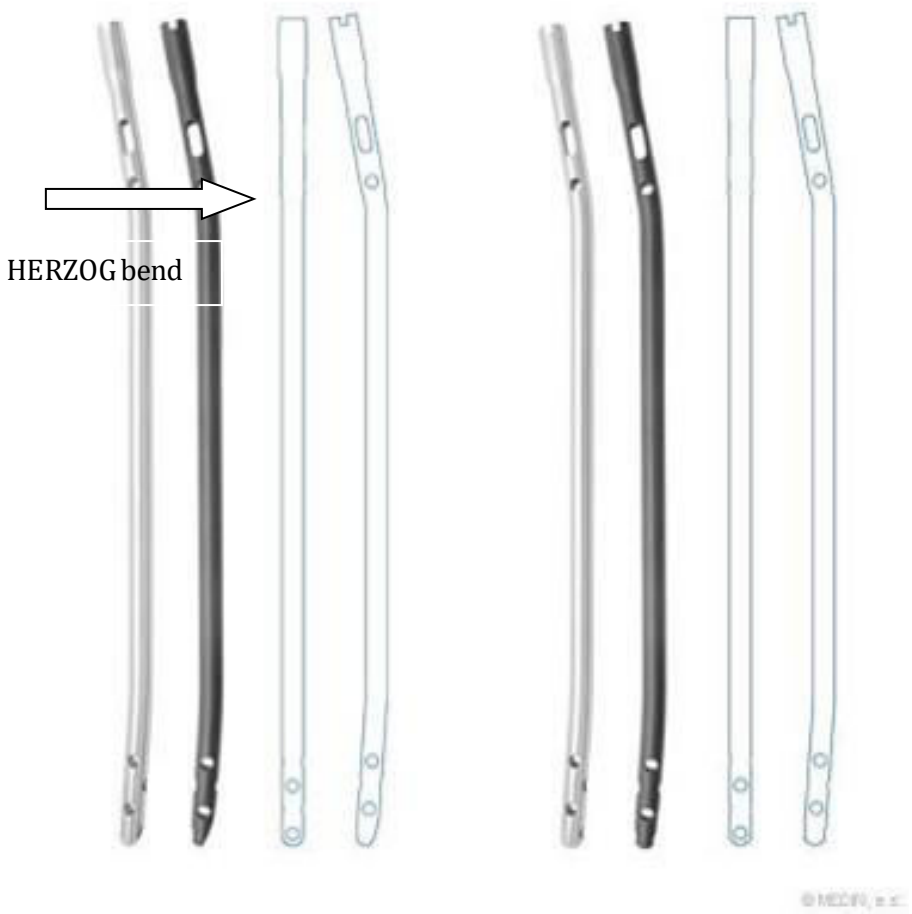
Figure 8. Entry Point



Intramedullary interlocking nails almost always provide a relative stability rather than absolute rigid fixation. There is only secondary bone healing with callus formation and no bone tobone primary healing. Distal locking screws are usually applied in static mode while the proximal locking can be done either in dynamic or static mode depending on the pattern of the fracture. The nail has to be inserted concentrically in 2

planes and one must be vigilant to not penetrate the posterior cortex. A special Herzog bend of 10^{o} in the proximal 50 mm is present in all AO IMIL tibia nails so as to ensure posterior cortex is not violated. Whether reamed or not, all tibia nails after insertion can cause considerable damage to the endosteal blood supply. The periosteal healing takes major part in fracture healing initially meanwhile the endosteal insult gets rectified in days to weeks. Before inserting the appropriate nail, reaming has to be done at least 2mm more than that of the diameter of the nail and nail should easily pass through the canal without and undue tightness or pressure.

Figure 9.Intramedullary Interlocking Tibia Nail[41]



TREATMENT OF ASSOCIATED FIBULAR FRACTURES :

Fibular fractures usually accompany tibial fractures because of the intimate relation between the 2 bones in the form of proximal tibio-fibular, distal tibio-fibular and interosseous connections in the middle third.Proximally the fibula anchors the lateral supports of the knee. Distally, it is the crucial lateral buttress for the talus and ankle joint.

The fibula is usually assumed to heal with whatever treatment is selected for the tibia. The high rate of union of fibular fractures is due to improved vascular supply associated with circumferential muscle coverage.

- In distal bothbone leg fractures, tibiofibular syndesmosis and interosseous membrane gets disrupted,fixation of fibula helps in healing of these soft tissues which further improves ankle stability.
- in distal both bone leg fractures fixation of tibia alone has difficulty in reduction and instability.
- anatomical reduction and fixation of the fibula fracture can be performed in advance to facilitate reduction of the tibia fracture and restoration of the stability.

If required fixation of fibula[19,38], it is carried out using fixation with tens nail,rush rods,k wires, small 3.5mm DCP or a 1/3rdtubular plate and screw system with 6 cortical purchases on either side of the fracture site.

fixation of fibula by open reduction & plate fixation has several disadvantages such as

- Extensive skin incision,
- Increased soft tissue damage.

- Increased risk of wound infection
- Hardware prominences

Fixation by closed reduction & internal fixation avoids such disadvantages and has advantage of preserving the fracture hematoma.

TENS NAIL

COMPLICATIONS SPECIFIC TO TIBIA AND FIBULA FRACTURES OF DISTAL THIRD REGION :

1. Wound complications :

Major wound healing problems are due to the primary insult occurring at the time of injury. A definite loss of radial blood supply can occur especially in case of closed and open degloving injuries. Utmost care and

respect have to be given for soft tissues and be vigilant for fracture blisters, increasing swelling and pain at the time of primary assessment to have a better outcome.

2. Infection post intramedullary interlocking nailing :

In cases of any form of infection with IMIL nail in situ and if optimum control of the infection could be obtained, the best possible advice is to continue treatment with the nail in situ and aim for fracture healing. If the infection worsens and is been present for a long duration, nail removal can be carried out with debridement of the canal with gentle reaming with insertion of another nail of a larger diameter with or without antibiotic-impregnated cement coating.

3. Superficialinfection :

Superficial infections are usually rare after closed fractures treated by closed reduction and fixation. The incidence increases only if there is significant soft tissue injury at the time of initial insult or in compound fractures or if open reduction methods are carried out to aid in fracture reduction. If the infection is superficial, intravenous antibiotics are sufficient for management. If the infection spreads to the deeper tissues,

opening up of the wound and debridement is carried out under the cover of higher antibiotics. A secondary healing is anticipated in these patients.

4. Delayed union and non-union:

Several factors have been implicated in the **cause** of delayed union and non-unions:-

- High velocity open fractures with skin or bone loss.
- Fractures with 100% displacement.
- Inadequate fixation that allows motion of the fractures site.
- Poor local blood supply.
- An intact fibula
- Infection present at the fracture site.
- Distraction at fracture site.

.**Methods of treatment** described are:-

•Dynamisation (locking bolts are removed from the larger or stable fracture fragment)

•Exchange nailing-i.e., previous implant is removed and replaced with a larger diameter nail with or without antibiotic impregnated cement coating.

Fibular osteotomy

•Bone grafting

5. Malunion and Shortening :

The four most important criteria for judging alignment of the tibia are:-

i) Angulation in antero-posterior and medio-lateral planes.

ii) Shortening.

iii) Rotational malalignment and

iv) Translation

Malalignment that is greater than 15^{o} irrespective of any plane with clinical symptoms referred to knee and ankle joint requires surgical methods of deformity correction.

According to **Trafton's criteria** of acceptable alignment,$5^{o}$of varus/valgus, $10^{o}$of Antero-posterior or rotational malalignment and 15 mm of shortening is the acceptable range. External rotation is well tolerated than internal rotation deformity.

Angulation in a tibial fracture is more significant in terms of its effect on ankle loading.

A mal-aligned tibial fracture has high chances for the development of Osteo-arthrosis in the adjacent joints. A osteotomy procedure is indicated only when the deformity is severe as well as symptomatic. Final aim is to restore the mechanical axis of the lower limb.

METHODOLOGY

Aim:

- TO ANALYSE AND EVALUATE FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF FIBULA BY CLOSED TENS NAILING IN ADDITION TO TIBIA IN DISTAL BOTH BONE LEG FRACTURES"

Objective:

1) Assessment of tibial malalignment clinically and radiographically in distal third fracture both bones leg patients treated by internal fixation of fibula followed by fixation of tibia with intramedullary interlocking nailing.

2) To assess the time of union of fractures.

3) To assess the functional outcome of fracture fixation in these patients.

Design: Prospective

Period: July 2016 to September 2018

Inclusion criteria

- Simple Distal both bone leg fractures
- Compound Grade I Fractures,
- Age more than 18 years.
- Both sexes

EXCLUSION CRITERIA

- Age less than 18 years.
- Compound Grade II, IIIa, IIIb, IIIc fractures
- Patient not fit for surgery due to comorbid conditions.
- Intraarticular fractures.

Timing Of Surgery: 3 to 11days from the time of injury.

Materials and Methods:

Source of DATA:

Patients with distal both bone leg fractures for whom fibular fixation by tens nailing followed by tibia nailing in Govt.Rajaji Hospital, Madurai from July 2016 until September 2018 with a minimum of 1 year of follow up.

Pre-Operative Assessment:

- X-ray of the fractured leg including one joint above and one joint below; including the ipsilateral Knee and Ankle Joints.
- Minimum two views are necessary : Antero-posterior and Lateral Views.
- Pre-Operative Nail length is measured clinically.
- Diameter of nail is measured using the Preoperative X-rays at the level of the Isthmus.

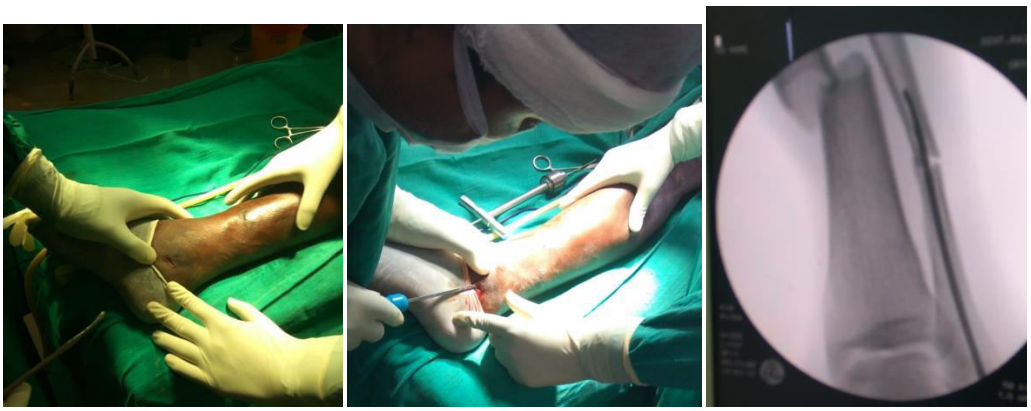
Procedure :

- **Fracture fibula was addressed first.**

1) fibula fixation technique :

Closed reduction & internal fixation of fibula by tens nailing :-

A small incision was made below the tip of the lateral malleolus.An awl was used to make an opening canal in the distal end of the fibula at anterolateral aspect, and a 2.5 or 3.0 mm elastic nail was inserted.Reduction of the fibula fracture was carried out under C-arm guidance and tens nail guided from distal fragment to proximal fragment.



2) <u>Technique of Intramedullary Nailing of Tibia[41] :</u>

All cases were operated under spinal anaesthesia.c-arm fluoroscopic guidance was used in all cases for closed reduction.

The patient was positioned supine on a radiolucent table. A radiolucent triangle bolster was used under the knee to maintain the position of hip in a flexion of $70^{o} – 90^{o}$ and knee flexion of $60^{o} – 90^{o}$.

The fractured leg was painted and draped .a sterile drape is used to cover the c-arm fluoroscope.

.a small 3cm incision is made at midline from inferior pole of patella to tibial tuberosity. A patellar tendon splitting approach was undertaken.A curved awl is used to open the medullary canal, proximal to the tibial tuberosity at the level corresponding to the proximal tip of the fibular head.. The bone awl was centered in the medullary canal.

A guide wire was inserted into the medullary canal of proximal fragment upto the fracture level then closed reduction done under carm guidance then guide wire passed into distal fragment and its position checked under c-arm in both ap & lateral view.The cannulated reamer was used for serial reaming upto the desired diameter.A nail with a diameter of 1 mm smaller than the final reamer was selected.


Then the nail of appropriate size as measured preoperatively was attached to handle and then inserted into through the guide wire into the medullary canal then reduction done and nail passed from proximal to distal fragment ,guide wire removed.nail inserted upto the metaphyseal region.

The distal locking done using two locking bolts,mostly two medio-lateral planes,in some cases antero posterior locking is done if no space for two medio lateral locking..

The proximal locking is done with two proximal locking done in almost all cases.

POST OPERATIVE PROTOCOL :

- Static Quadriceps and Ankle Pump exercises started at At the **end of 48 hrs** .
- Active Knee ROM exercises were started.
- EOT done on **3rd ,6th & 9th post operative day**.
- Suture removal was done on **11thPost operative day**.
- Full ROM of Knee at discharge on **12th Post-op day**.
- Non – Weight bearing for 6 wks ; 1st visit after 6 wks,
- Partial Weight bearing started after evidence of callus formation (6wks to 3 months) and,
- Full wt. bearing started when there is radiological union of 3 cortices.

Postoperatively Patients were followed up Clinically and Radiologically at 6wks, 3 months, and 6 months & 1 year and then yearly intervals until the fracture heal completely.

Orthopaedic Trauma Association classification was used at the time of admission and fractures were classified according to it . Nature of the injury was also noted.

Postoperative radiographs were taken to asses the tibial malallignment. The degree of the tibial angulation (varus or valgus), (Antero-posterior), (rotational) and shorteningwere evaluated radiologically and clinically.

At the end of one year, the range of movement [dorsiflexion and plantar flexion] at the ankle was determined. Functional assessment of ankle function is done by **"Ankle-Evaluation Rating System"** by **Merchant and Deitz**

"Johner&Wruhs' Criteria" was used for final evaluation

Postoperative Scoring system :-

1. Clinical Assessment :-

❖ **Ankle Evaluation and Rating system by *Merchant &Deitz*: (100 POINT SCALE)**

10 POINTS : Motion at Ankle

- 40 POINTS : Function
- 40 POINTS : Pain
- 10 POINTS : Gait

Merchant und Dietz Score

Anwendung	Frakturen	
Funktion (40 points)	Does housework or job without difficulty	8
	Climbs stairs:	
	Foot over foot	6
	Any manner	4
	Carries heavy objects, such as a suitcase	4
	Is able to run, participates in athletics, or work at heavy labor	4
	Walks enough to be independent	8
	Does yard work, gardening, lawn mowing	4
	Has no difficulty getting in or out of an automobile	6
Freedom of pain	No pain	40
	Pain only with fatigue or prolonged use	30
	Pain with weight-bearing	20
	Pain with motion	10
	Pain with rest or continuous pain	0
Gait	No limp	10
	Antalgic limp	8
	Uses cane or one crutch	2
	Uses wheelchair or can't walk	0
Range of motion	Total amount of dorsiflexion and plantar flexion (normal 30-70°); assign 2 points for every 20°	10
Result:	90-100 points	excellent
	80-89 points	good
	70-79 points	fair
	< 70 points	poor

❖ **Range Of Motion Analysis of Ankle Joint :-**

Poor :< 50 %

Fair : 50 to 75%

Good : 75 to 99%

Excellent : 100% motion

2. **Radiological Assessment :**

❖ **Degree of Varus/Valgus angulation at the fracture site:**

Poor : 10 degree

Fair : 6 to 10 degree

Good : 2 to 5 degree

Excellent : 0 to 1 degree

❖ **Evidence of union at the Fracture site**

❖ Final Analysis and Evaluation is based on ***Johner and Wruchs[40]' Criteria*** and classified as **Excellent, Good, Fair and Poor Outcomes.**

	Excellent	**Good**	**Fair**	**Poor**
Nonunion	None	None	None	Yes
Tibial Deformity (Varus/Valgus)	None	2-5 ^{o}	6-10 ^{o}	>10 ^{o}
Mobility at Ankle (%)	Normal	>75 %	50 – 75%	< 50%
Gait	Normal	Normal	Insignificant limp	Significant limp

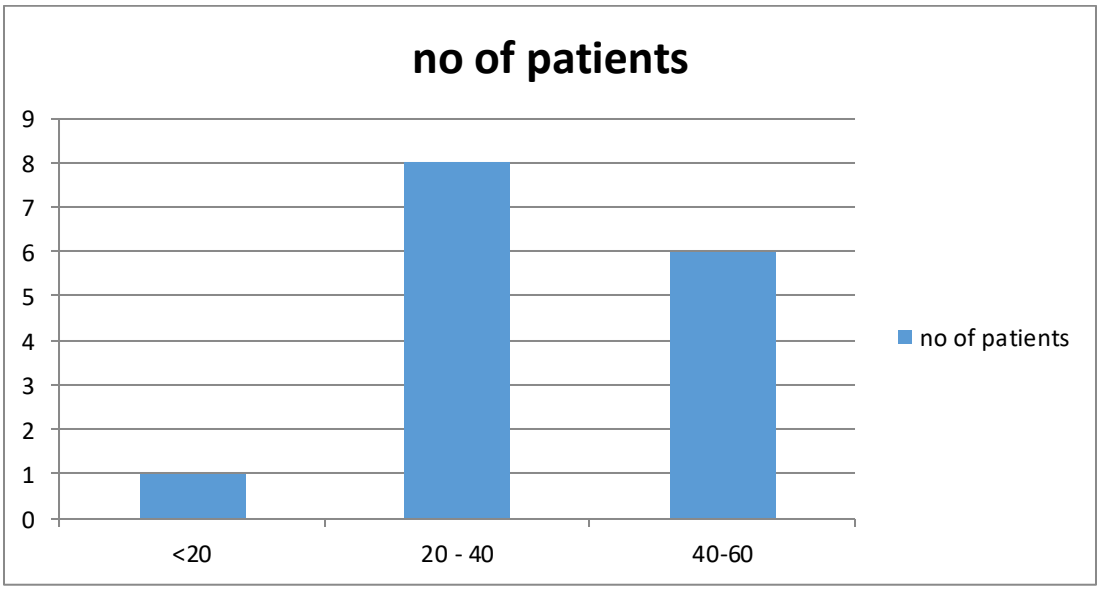
OBSERVATION AND RESULTS :

1. AGE DISTRIBUTION:

Among the 15 patients studied,highest number of patients were seen in 20-40 years (53.3%) age group. The average was37.2 years.

TABLE 1 –AGE DISTRIBUTION

AGE (YEARS)	Frequency	Percentage (%)
<20	1	6.6
20 – 40	8	53.3
40 – 60	6	40.1
TOTAL	**15**	**100**



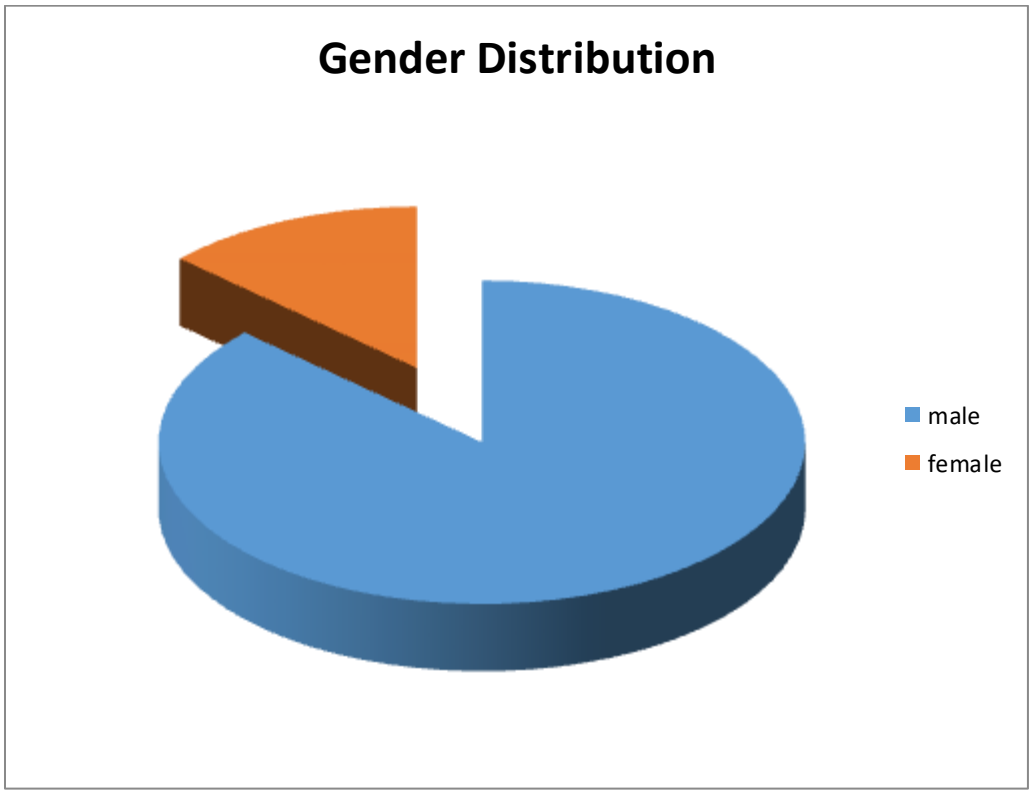
AGE (in years)

2. GENDER DISTRIBUTION:

Among the 15 cases there were 12 Male and 3 Female patients with **predominant Male** distribution;

TABLE 2 – GENDER DISTRIBUTION

GENDER	Frequency	Percentage (%)
MALE	12	80
FEMALE	3	20
TOTAL	**15**	**100**

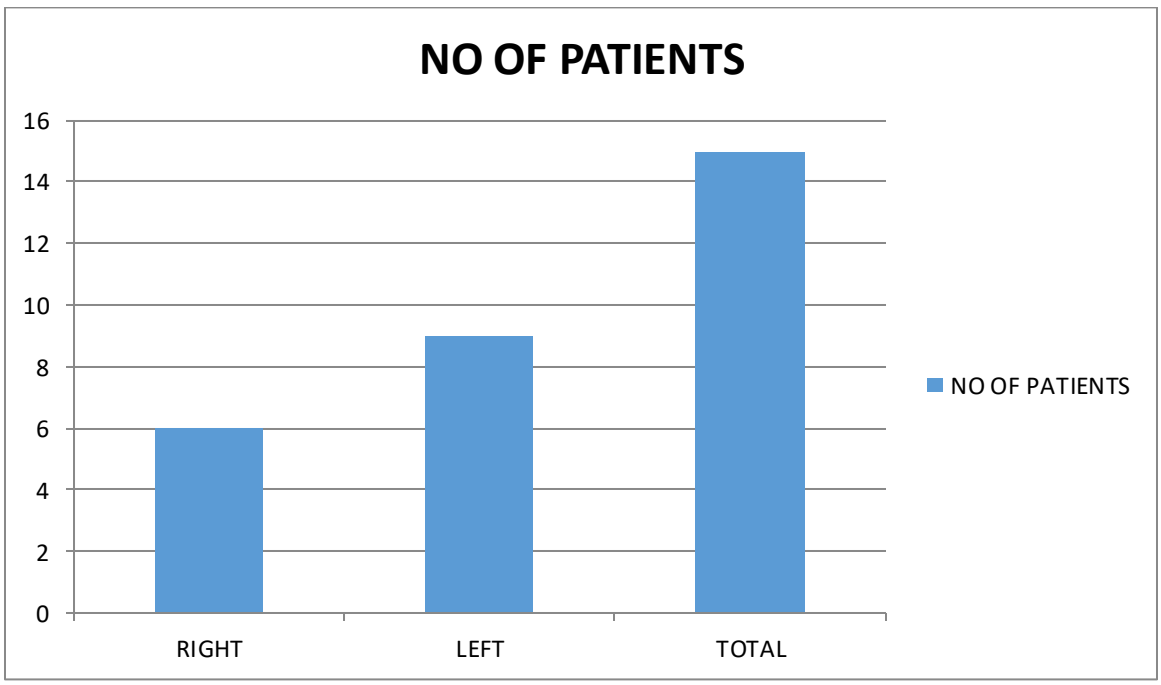


3. SIDE DISTRIBUTION:

Among the patients studied most of the patients had affected **left** side compared with left.

TABLE : 3- SIDE DISTRIBUTION

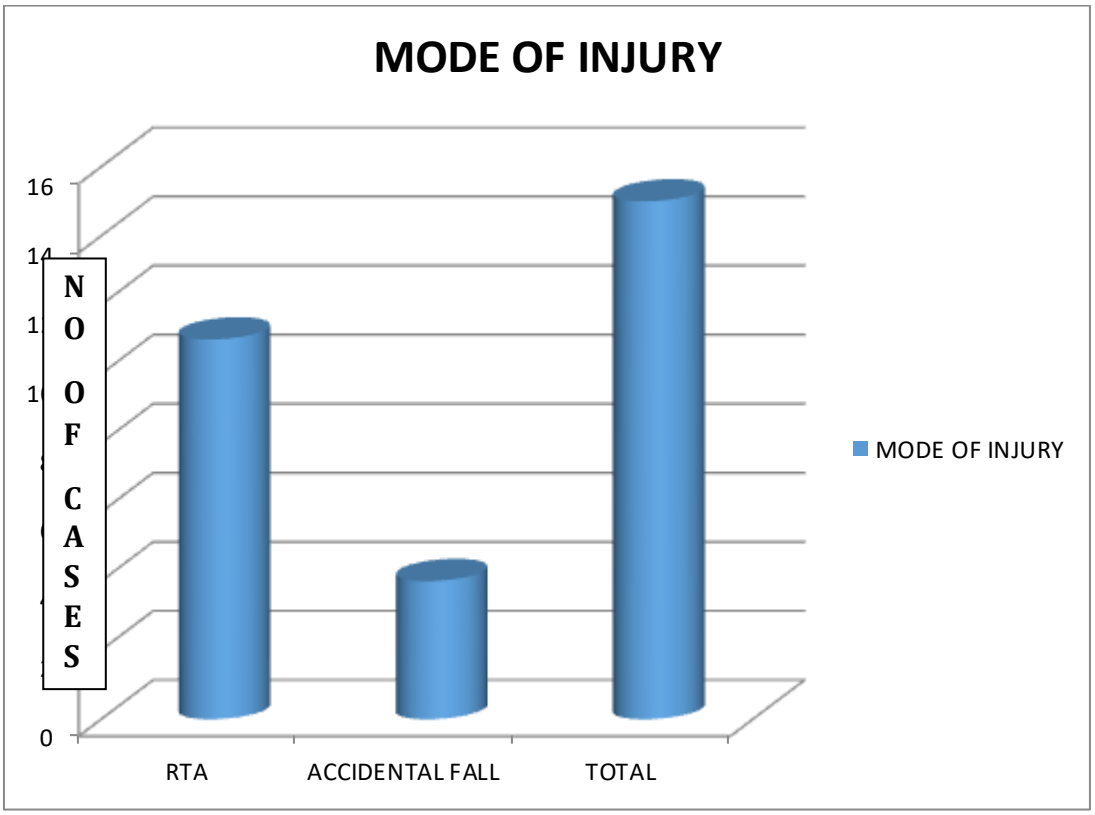
SIDE	Frequency	Percentage (%)
RIGHT	6	40
LEFT	9	60
TOTAL	**15**	**100**



4. MODE OF INJURY :

Table 4 – Mode of Injury

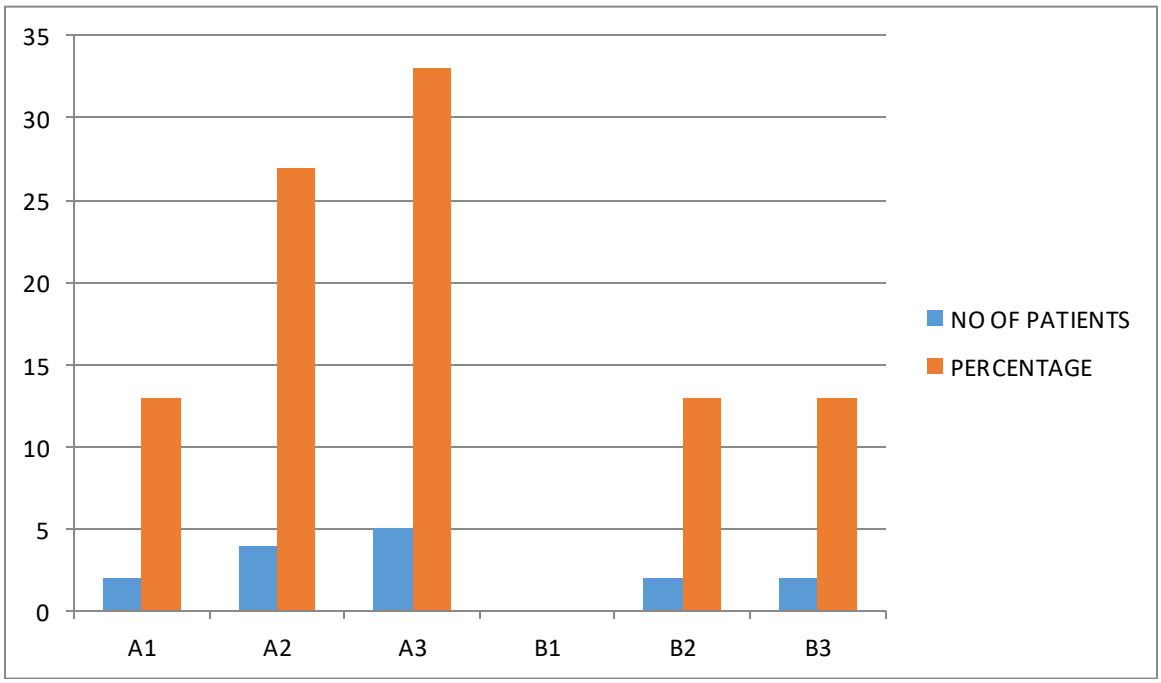
	Frequency	Percentage (%)
RTA (WHEELER VS WHEELER)	11	73.3
Accidental Fall	4	26.7
Total	**15**	**100**



5. FRACTURE CLASSIFICATION (OTA Classification)

TABLE : 5 – CLASSIFICATION (OTA Classification)

Classification	Frequency	Percentage (%)
A1	2	13.3
A2	4	26.6
A3	5	33.3
B2	2	13.4
B3	2	13.4
TOTAL	**15**	**100**

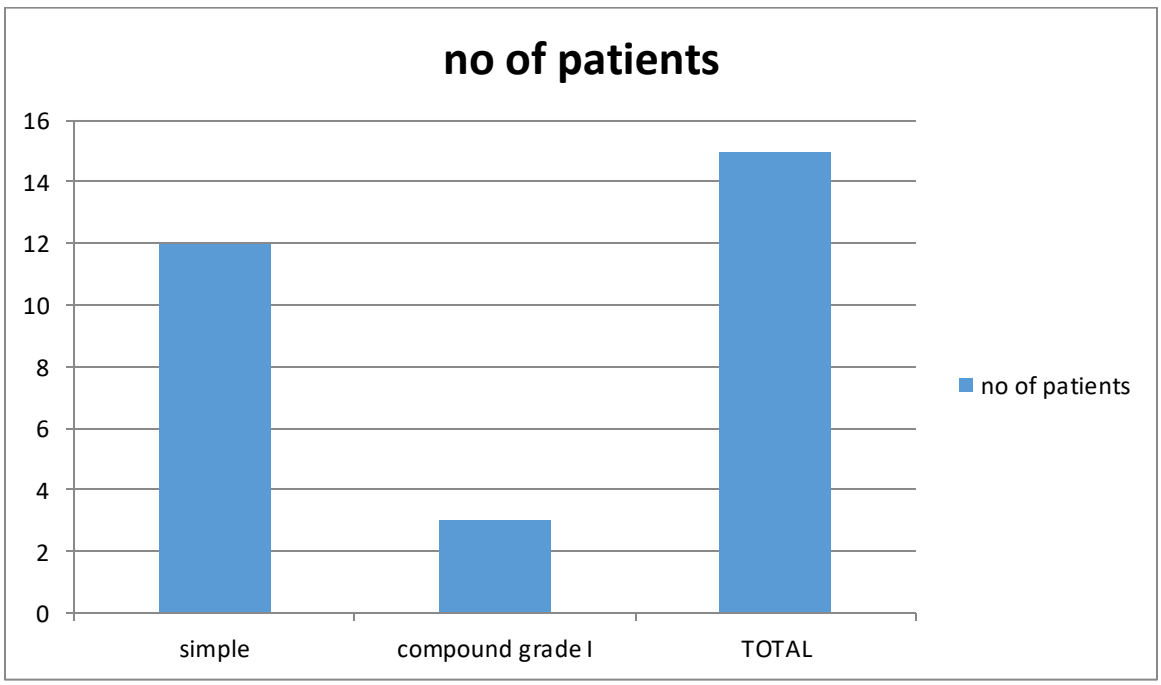


6. OPEN / CLOSED INJURIES :

Table 6

Type of Fracture (Gustilo and Anderson's Classification)

Type	Frequency	Percentage (%)
Open - Grade I	3	20
Closed	12	80
Total	**15**	**100**

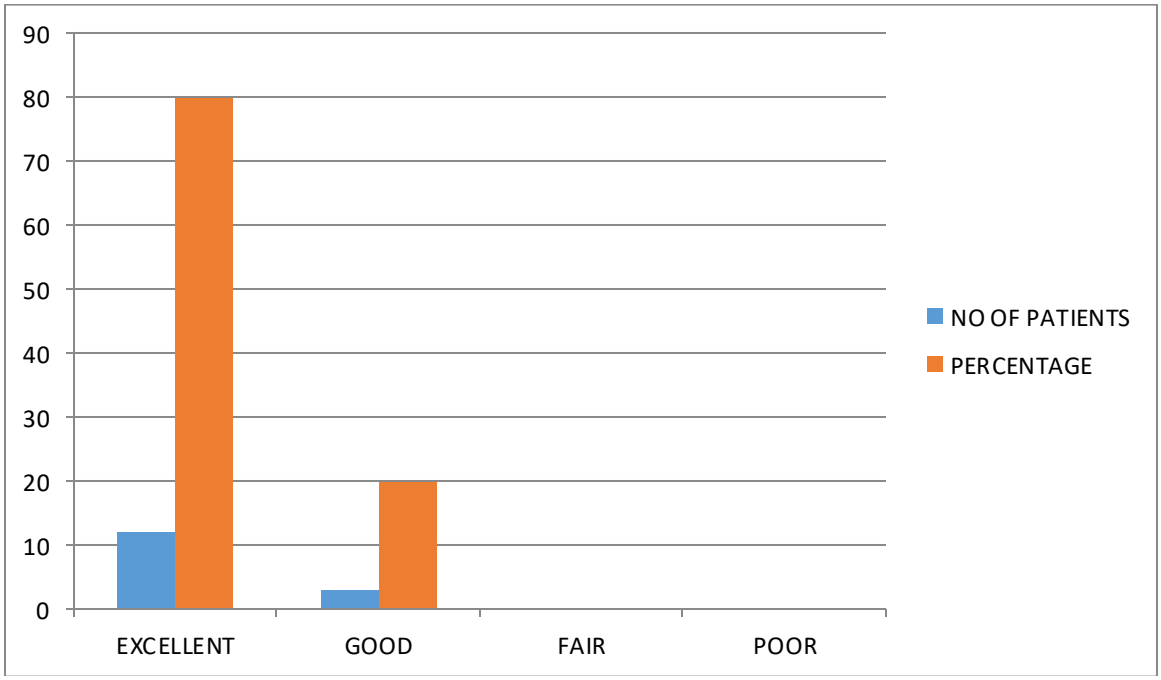


6. RADIOLOGICAL VALGUS/VARUS ANGULATION OF TIBIA :

Among 15 patients oly 6 patients had varus angulation and mean average value being 2 degrees.

Table 7

Valgus/Varus (in degrees)	Frequency	Percentage
Excellent (0-1)	12	80
Good (2-5)	3	20
Total	15	100

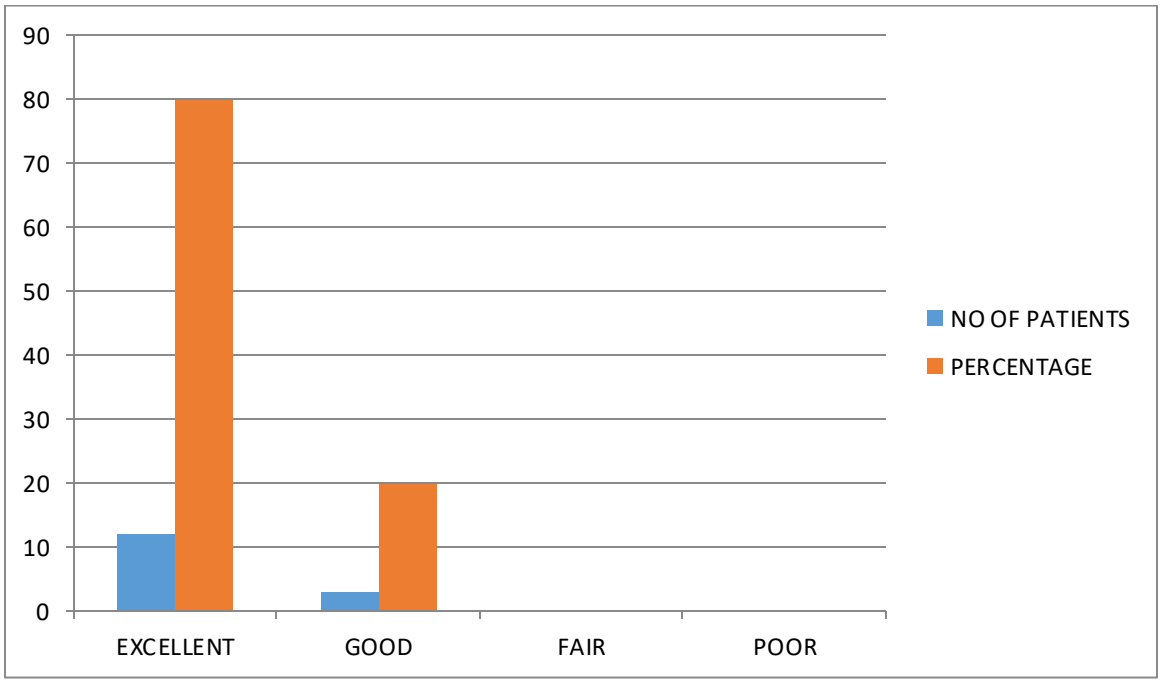


8. ANKLE RANGE OF MOTION :

Table 8

Ankle Range Of Motion

Range Of Motion	Frequency	Percentage (%)
Excellent (100%)	12	80
Good (75 – 100%)	3	20
Fair (50 – 75%)	-	-
Poor (<50%)	-	-
Total	**15**	**100**



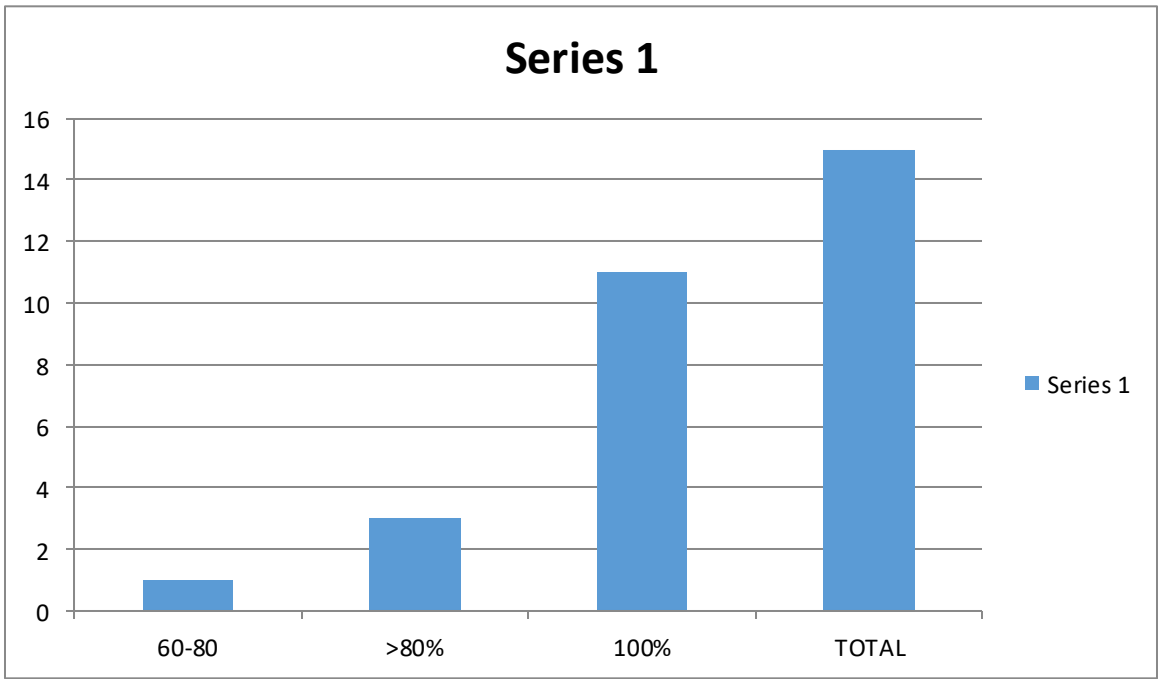
9. ANKLE EVALUATION RATING (CLINICAL) :

THE MEAN SCORE OF 15 PATIENTS WAS 92

Table 9

Pattern of clinical Ankle Evaluation Rating System (AERS) Score

Ankle Evaluation Score (Total 100 Points)	Frequency	Percentage (%)
<60	-	-
60 – 80	1	13.3
>80	3	20
100%	11	66.7
Total	**15**	**100**



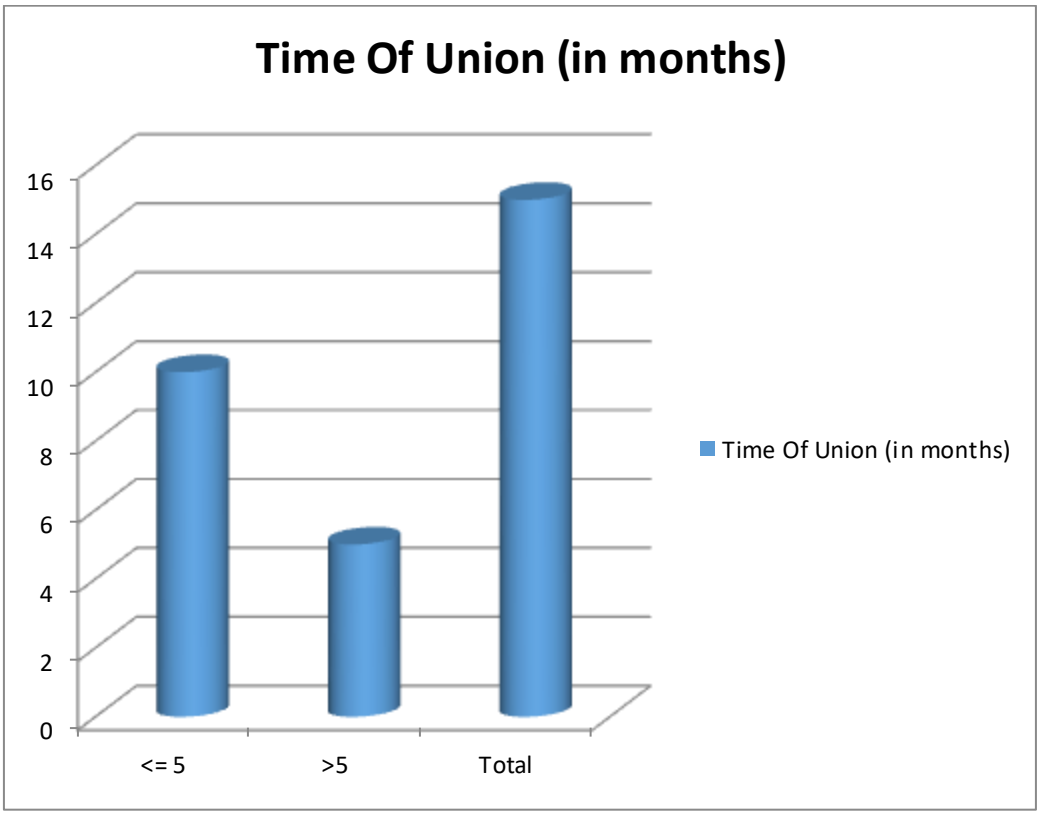
AERS Score (maximum 100 POINTS)

10. TIMEOF UNION :

Table 10

Pattern of Time of Union

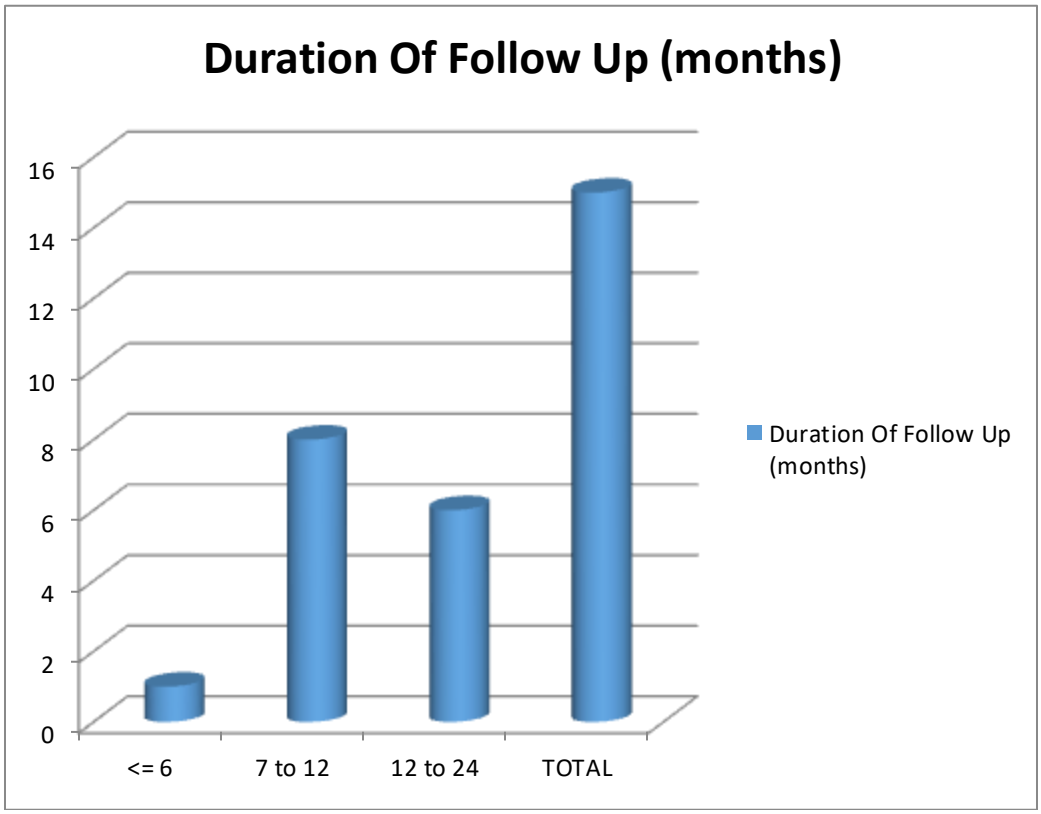
Time Of Union (in Months)	Frequency	Percentage (%)
<= 5	10	66.6
>5	5	33.3
Total	**15**	**100**



11. DURATION OF FOLLOW UP :

Table 11

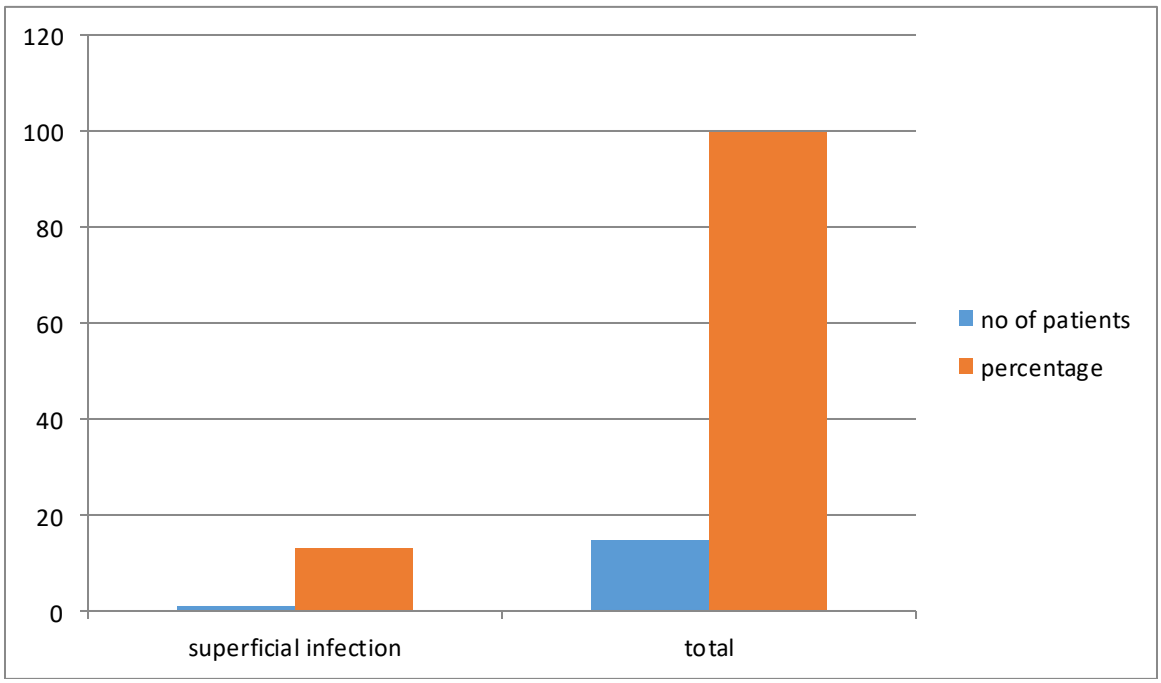
Duration of Follow up	Frequency	Percentage
<= 6 months	1	6.6
7 – 12 months	8	53.3
12 – 24 months	6	40
Total	**15**	**100**



12. COMPLICATIONS :

Table 12

Complications	Frequency	Percentage (%)
Superficial Infection	1	6.6%
Total	**15**	**100**

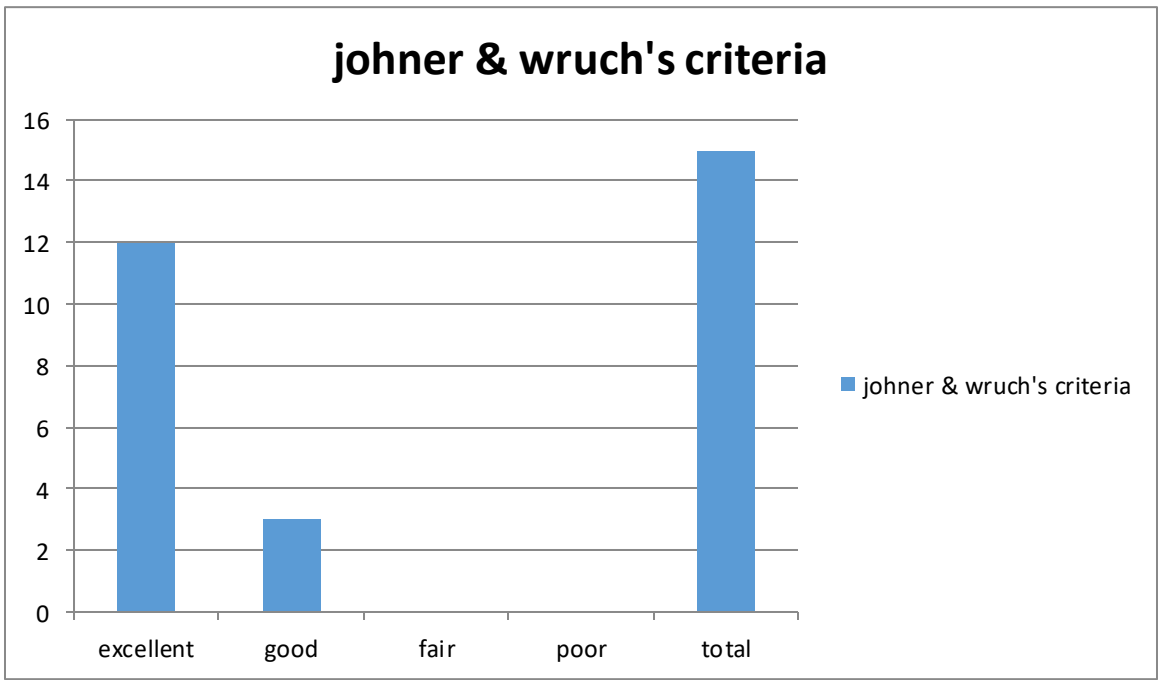


13. JOHNER AND WRUCH'S CRITERIA

Table 13

Final Results according to Johner and Wruch's Criteria

Results	Frequency	Percentage (%)
Excellent	12	80
Good	3	20
Fair		
p		
Total	**15**	**100**



RESULTS

Fifteen patients with fractures of distal third of tibia and fibula who were treated by fixation of fibula by closed tens nail followed by tibia nailing ,in Department Of Orthopaedics and Traumatology, Govt. Rajaji Hospital, Madurai were followed up in the study.

Average follow up being 11.3months with longest followup of 1 year and 8 months and shortest being 7 months.

Age incidence ranged from 19 to 60 years with average age being 37.2 years

Mode of the injury:

Most cases were due to road traffic accidents (73.3%). The Other mechanism being accidental fall from height (26.6%).

Side of the fracture :

The left side was more commonly involved [9 in number] than the right side [6 in number].

Type of fracture [Open or closed]:

In this study, 80% of cases were closed fractures and 20% were open fractures of the tibia. open fractures 3 were of compound Grade I (20%) according to Gustilo and Anderson's Classification.

ASSESSMENT OF RADIOLOGICAL VALGUS/VARUS ANGULATION:

In this study among 15 patients 9 patients did not have any angulation,6 patients had varus angulation with mean varus of 2degrees,none of the patients had valgus angulation, the patients were divided into 4 Groups :

1. Poor :>10^{o} valgus / varus
2. Fair : 6 – 10^{o}valgus / varus
3. Good : 2 – 5^{o}valgus / varus
4. Excellent : 0 -1^{o}valgus / varus

.

Antero-Posterior Malalignment:

None of the patients had antero-posterior angulation.

Rotational malalignment and Shortening :

None of the patients had rotational malalignment and shortening.

RANGE OF MOVEMENTS AT THE ANKLE [EXPRESSED AS A PERCENTAGE] :

The mean range of movements in patients with fibula fixation was 96%. To assess the range of movements at the ankle, the patients were divided in to 4 groups :

1. Excellent : 100% motion of ankle
2. Good : >75% motion of ankle
3. Fair : 50 – 75% motion of ankle
4. Poor : <50% motion of ankle

Among the 15 patients ; 11 patients(73.3) had excellent results, 4 patients(26.7) had good result,with no fair & poor results.

Ankle evaluation :

Assessment of ankle function according to the **CRITERIA OF MERCHANT AND DIETZ** was observed at the end of 1 year followp. It is a 100 point scale allotting 40 points for function, 40 for pain, and 10 for gait and 10 points for range of motion at the ankle.

The mean clinical score was 92 points.

Time of union :

Mean time of union in these patients was 5 months (minimum of 4 months and a maximum of 7 months).

Complications:

- 1 out of 15 patient had wound complications at the Fibular tens nail incision site. it was a superficial infection which were treated with intravenous antibiotics.

JOHNER AND WRUCH'S CRITERIA :

The patients were assessed for nonunion,deformity,mobility of ankle & gait :

	EXCELLENT(NO.OF PTS.)	**GOOD (NO.OF PTS.)**	**FAIR(NO .OF PTS.)**	**POOR(N O.OF PTS.)**
NONUNION	None(**15**)	None(**nil**)	None(**nil**)	Yes(**nil**)
TIBIAL DEFORMITY (VARUS/VAL GUS)	None(**12**)	2-5^{o}(**3**)	6-10^{o}**nil**)	>10 ^{o}(**nil**)
MOBILITY AT ANKLE (%)	Normal(**12**)	>75%(**3**)	50 – 75%(**nil**)	< 50%(**nil**)
GAIT	Normal(**15**)	Normal (**nil**)	Insignifica nt limp(**nil**)	Significant limp(**nil**)

Among the 15 patients, 12patients (80%) had excellent result, 3(20%) had good results, . There was no fair and poor result.

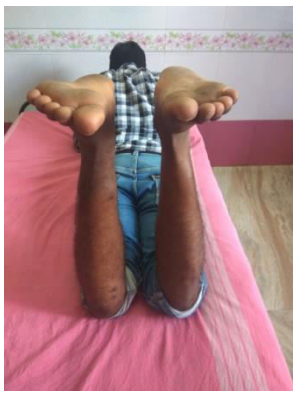
CASE - 1

AGE/SEX: 22/M ;**I.P.No :** 8412
JOHNER AND WRUCH'S CRITERIA : EXCELLENT

CLINICAL PICTURE PRE-OP :AP View PRE-OP : Lat View

2 weeks POST-OP XRAY – Antero-posterior and Lateral Views

1 year FOLLOW UP XRAYS –AP AND LATERAL VIEWS SHOWING NO VARUS/VALGUS DEFORMITY



ROM – Dorsiflexion (0 to 20 degrees)

thigh foot axis 7degrees

ROM –Plantarflexion (0 to 40 degrees)

CASE - 2

AGE/SEX: 42/M ;**I.P.No. - 8546**
JOHNER AND WRUCH'S CRITERIA : Excellent

CLINICAL PICTURE PRE-OP :AP View PRE-OP : Lat. View

Immediate POST OP XRAY **1 year 6 months**

FOLLOW UP XRAY SHOWING 3GEDREE OFVARUS

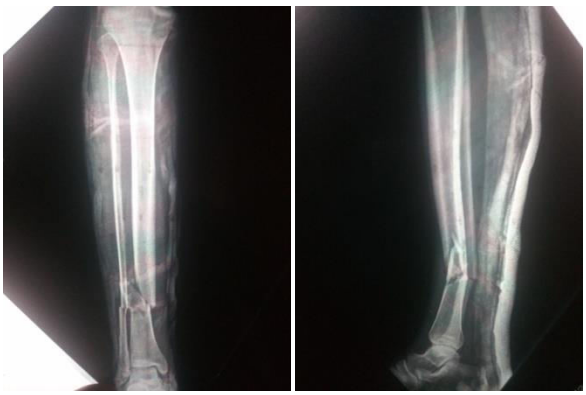
ROM-Dorsiflexion (0 to 20 degrees) **thigh foot axis** **ROM-Plantarflexion (0 to 45 degrees)**

Clinical Picture

CASE - 3

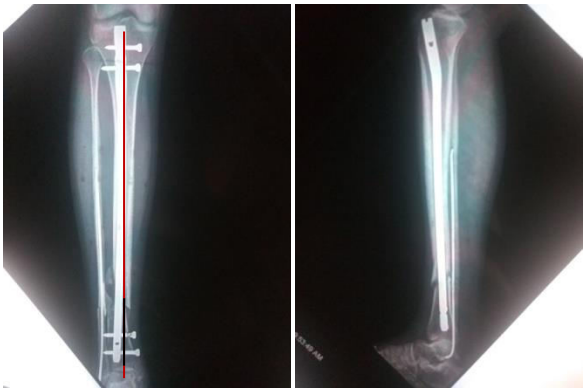
AGE/SEX: 21/M ;**I.P.No.**7712
JOHNER AND WRUCH'S CRITERIA : GOOD

CLINICAL PICTURE



PRE-OP :AP View **PRE-OP : Lat View**

3 weeks POST OP XRAY – AP AND LATERAL VIEWS



12 months FOLLOW UP XRAY – AP AND LATERAL VIEWS SHOWING NO VARUS/VALGUS DEFORMITY

ROM – Dorsiflexion (0 to 20 degrees) **THIGHFOOT AXIS (0 to 40 degrees)** **ROM – Plantarflexion**

clinical picture

CASE - 4

AGE/SEX: 37/M ;**I.P.No.** 7180
JOHNER AND WRUCH'S CRITERIA : EXCELLENT

CLINICAL PICTURE

PRE-OP :AP View

PRE-OP : Lat. View

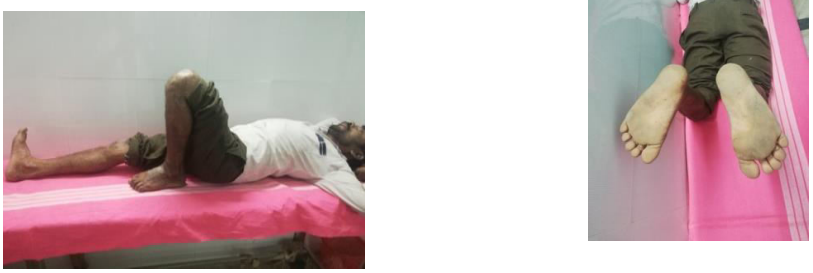
POST-OP XRAY : AP View

POST-OP XRAY : LATERAL View

1 year 3 months Follow up Xray– AP AND LATERAL VIEWS SHOWING 2 DEGREE OF VARUS DEFORMITY

CLINICALPICTURE ANKLE ROM-DORSIFLEXION PLANTAR FLEXION

(0-10DEGREE) (0-40DEGREE)



KNEE ROM-FLEXION THIGH FOOT AXIS

CASE-5

AGE/SEX: 57/f ;**I.P.No.** 10151

JOHNER AND WRUCH'S CRITERIA : GOOD

Clinical Picture

Pre-Op X-rays :- AP and Lateral Views

Immediate Post-Op X-rays :- Antero-posterior and Lateral Views

10 months follow up Post OP X-rays :- AP and Lateral Views showing no varus/valgus tibial deformity.

ROM – Dorsi-flexion

(0 to 20 degrees)

ROM – Plantar Flexion

(0 to 40 degrees)

ROM – Knee Flexion .thigh foot axis

COMPLICATIONS :

SUPERFICIAL INFECTION

DISCUSSION

In the fractures of both bones of leg involving the distal third region, the importance of fixing of fibular fracture has not yet been clearly analysed. This study was conducted in 15 patients to analyse the results of fixing the fibula fracture in fractures of the lower third of shaft of tibia and fibula. In all of the cases, the fracture tibia was treated with interlocking intramedullary nailing.

In 6 out of 15 patients, there was mild amount of valgus/varus angulation at the fracture site within the acceptable range. The average varus angulation was 2. degrees and there was no valgus angulation.. In comparison to the previous studies where fibula was

treated conservatively in fractures of distal third of tibia and fibula, the valgus and varus angulation in our study was significantly less.Acceptable angulation being 5 degrees.

Following are the Literature support;

In Journal of Orthopaedic Trauma:[32]February 2006 - Volume 20 - Issue 2 - pp94-103; It was proposed that, the proportion of fractures that lost alignment was very minimal among those receiving stabilization for fibula fracture in conjunction with IM nailing in comparison with those candidates receiving IM nailing alone. The authors insisted on fibular fixation whenever IM nailing is contemplated in the unstable distal tibia-fibular fracture.

In Journal of Orthopaedic Trauma:[33] January 2009 ; Vol. 1, no. 1, 33-40(2009)

Concluded that fibula fixation and intramedullary nailing of distal Tibial-Fibular fractures is a valid technique which prevents malalignment and respects soft tissue envelope.

Journal Of Orthopaedics&Traumatology[34] : Surgery and Research (2010) 96, 674-682 ; In laboratory simulation, fibular fixation initially increased stability by decreasing initial rotational displacement in nailed distal third tibial fractures. These data support our clinical observations

that fibular fixation may decrease late valgus malalignment in distal third comminutedtibial fractures with a fibular fracture at the same level.

Journal Of Bone and Joint Surgery*[19] *American 2003 Apr; 85-A(4) :604-8

Fibular plate fixation increased the initial rotational stability after distal tibial fracture compared with that provided by tibial intramedullary nailing alone. However, there was no difference in rotational structural stiffness between the specimens treated with and without plate fixation as applied torque was increased.

Comparing the results of this study with the above mentioned literature, when the fixation of fibula[39] is done prior to nailing of tibia, it helps in alignment of the proximal and distal tibial fragments and maintains the length of lateral column[34], thereby reducing the incidence of varus/valgus mal-alignment at the fracture site.

The average range of motion at the ankle in our study **96%**.

Literature Support :Merchant and Deitz[5] [1989] in their clinical study of 3717patients followed up for 29 years, had a mean ankle evaluation score of **88.4 points** for patients with distal third of the shaft of tibia. All of the patients in their series were treated non-operatively with a cast.

In our study, the mean score was high **92 points** when compared to the study by **Merchant &Deitz** may be accounted to the shorter duration of the follow up [the longest duration of follow up being one year six months with a mean duration of 11.3 months].

One out of 15 patients treated with fixation of fibula developed superficial wound infections over the fibular incision site. It was controlled by appropriate dressing and antibiotics.

The average union time was 5 months; minimum of 4 months and a maximum of 6 months.There were no non-unions. Comparing our results with previous studies conducted by **Jeffrey and his colleagues[18] in 2004,** the time of union was not influenced by fixation of fibula. All fractures united within the acceptable duration for union.

Final analysis of results according to **Johner&Wruh's** criteria showed Excellent to good outcome in most of the patients (12 patients, 80%) and favorable in 3(20%) of the patients.

LIMITATIONS OF THE STUDY :

1. Sample size is small when compared with other similar studies.
2. Duration of follow up when compared to other studies is less. Average duration in our study is 11.3 months.

SUGGESTIONS :

1. A larger sample size would help in improving the quality of the study.
2. Duration of follow up has to be longer so as to assess the complications like osteoarthritis at the ankle and functional disability.

CONCLUSION :

Based on the Results of the study the following conclusions were made :

1. Fixation of fibula in cases of distal third fractures of both bones of leg where tibial fracture is treated by intramedullary interlocking nail offer better outcomes by reducing the incidence of tibialmalalignment (varus/valgus) and **maintaining the length** .

2. Fibula fixation prior to fixation of tibia helps in restoring the height of the lateral column and **helps in reduction of the tibia**

anatomically. This may be the reason for **less valgus/varus angulation** in cases where fibula was fixed[34].

3. Closed fixation of fibula leads to good **soft tissue healing and syndesmosis**.Hence the Functional scores at 1 year showed better results when compared to fixation by plating & conservative management of fibula. it **also avoids large skin incision,periosteal stripping ,soft tissue damage etc required for plate fixation** .

4. There was no significance with respect to the time of union when comparing our results with the previous studies where fibular fracture was not fixed.

5. According to Criteria by JOHNER and WRUCH's, most of the patients(80%) had excellent outcome.

When compared to previous studies the outcome assessment by this criteria showed a better results in our patients where fibula fixation is carried out.

In conclusion, treatment of distal third both bone leg fractures by fixation of fibula by closed tens nailing followed by tibia

nailing is useful in anatomical reduction of tibia & reduced malalignment of tibia with good ankle functions . Further Randomized control studies are needed to assess the long term functional outcome in these patients.

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ANNEXURE I

PROFORMA FOR FRACTURE BOTH BONES LOWER THIRD OF LEG

1. **Name of the patient**

2. Age

3. Sex

4..Hospital IP No.

5.Address

6.Date of Admission :

Date of Discharge :

Date of Injury :

Date of Surgery :

7.Nature of Injury:

RTA

Fall from height

Simple fall

8.FRACTURE CLASSIFICATION

(a) OTA Classification

A1 - A2 - A3 -

B1 - B2 - B3 -

C1 - C2 - C3 -

(b) Open fracture (Gustilo& Anderson)

I - II - IIIA - IIIB -

IIIC –

9. Limb involved :

(R) - (L) –

10 Surgery Done :

a. TIBIA

Closed IL nailing – Reamed / Unreamed

b. FIBULA

closed reduction & internal fixation with TENS nail.

11. Follow Up:

1) 6 weeks - 2) 3 months - 3) 6months - 4) 1 year -

12.RADIOLOGICAL ASSESSMENT OF TIBIAL MAL ALIGNMENT :

VARUS [in Degrees]

VALGUS [in Degrees]

13.Range of Movements at the ankle at 6 month follow up :

Dorsi flexion -

Plantar flexion -

Total as a percentage –

14.Ankle evaluation scoring system [Merchant & Dietz]

A)FUNCTION (points) -

Does housework or job without difficulty (8)

Climbs stairs foot over foot (6)

Climb stairs any manner (4)

Carries heavy objects such as suit case (4)

Is able to run, participate in athletic's or heavy labor (4)

Walks enough to be independent (8)

Does yard work, gardening (4)

Has no difficulty getting in or out of automobile (6)

TOTAL (40)

B)FREEDOM FROM PAIN -

No pain (40)

Pain only with fatigue or prolonged use (30)

Pain with weight bearing (20)

Pain with motion (10)

Pain with rest or continuous pain (0)

TOTAL (40)

C)GAIT -

No limp (10)

Antalgic limp (8)

Uses cane or one crutch (2)

Uses wheel chair or cannot walk (0) *{TOTAL(10)}*

D)RANGE OF MOTION -

Total amount of dorsiflexion & plantar flexion (Normal 30 – 70 ^{o}) assign two points for every 20^{o}

TOTAL (10)

15. Time of Union in Months :

16.Complications :

Non union Superficial infection Deep infection Malunion

17.CRITERIA FOR EVALUATION OF FINAL RESULTS [JOHNER & WRUCHS]

	Excellent	Good	Fair	Poor
Nonunion	**None**	**None**	**None**	**Yes**
Tibial Deformity (Varus/Valgus)	**None**	**2-5°**	**6-10°**	**>10°**
Mobility at Ankle (%)	**Normal**	**>75 %**	**50 – 75%**	**< 50%**
Gait	**Normal**	**Normal**	**Insignificant limp**	**Significant limp**

- Final Analysis and Evaluation is based on ***Johner and Wruchs' Criteria*** and classified as **Excellent, Good, Fair and Poor Outcomes.**

ANNEXURE-II

CONSENT FORM FOR OPERATION/ANAESTHESIA

I_____ Hosp. No._____ in my full senses hereby give my full

consent for _____ or any other procedure deemed fit which is a diagnostic procedure / biopsy / transfusion / operation to be performed on me / my son / mydaughter / my ward_____age under any anaesthesia deemed fit. The nature,risks andcomplications involved in the procedure have been explained to me in my ownlanguage and to my satisfaction. For academic and scientific purpose theoperation/procedure may be photographed or televised.

Date:

Signature/Thumb Impression

of Patient/Guardian

Name:

Designation Guardian Relation ship

Full address

S.NO	NAME	AGE	SEX	SIDE	AO TYPE	TIME SINCE INJURY	DURATION OF FOLLOW UP	TIME OF UNION	VALGUS DEGREE	ROM (%)	AERS (POINTS)	JOHNER &WRUCHS	COMPLICATIONS	MOE OF INJURY
1	VICKY	22	M	L	B3	3 DAYS	50 MIN	1 YR 6 MONTHS	0 DEG	100	100	EXCELLENT	-	RTA
2	AYYANAR	21	M	R	B3	5 DAYS	55 MIN	1 YR	1 DEG	100	92	EXCELLENT	-	RTA
3	RANJITH	19	M	R	A3	3 DAYS	1 HR	1 YR 3 MONTHS	0 DE	90	100	EXCELLENT	-	RTA
4	BALASUBRAMANIAM	42	M	L	A3	7 DAYS	40 MIN	1 YR 2 MONTHS	0 DEG	100	96	EXCELLENT	-	RTA
5	KAMALAM	60	F	R	A1	10 DAYS	1 HR 5 MIN	1 YR	3 DEG	100	100	EXCELLENT	-	ACCFALL
6	CHITTUPILLAI	57	F	R	A2	7 DAYS	50 MIN	1 YR	1 DEG	100	100	EXCELLENT	-	ACCFALL
7	MARIYAMMAL	60	F	R	A1	10 DAYS	1 HR	1 YR	0 DEG	90	100	EXCELLENT	SUPERFICIAL INFECTION	ACCFALL

8	**LEELA**	**50**	**F**	**L**	**A2**	**7 DAYS**	**1 HR 5 MIN**	**1 YR 4 MONTHS**	**0 DEG**	**90**	**100**	**EXCELLENT**	**-**	**RTA**
9	**ARUMUGA PERUMAL**	**55**	**M**	**L**	**B2**	**10 DAYS**	**1 HR 10 MIN**	**1 YR**	**0 DEG**	**100**	**100**	**EXCELLENT**	**-**	**RTA**
10	**KALYANA SUNDARAM**	**37**	**M**	**R**	**A3**	**3 DAYS**	**55 MIN**	**1 YR**	**1 DEG**	**90**	**100**	**EXCELLENT**	**-**	**RTA**
11	**VIGNESH**	**23**	**M**	**L**	**A3**	**5 DAYS**	**50 MIN**	**1 YR**	**0 DEG**	**100**	**100**	**EXCELLENT**	**-**	**RTA**
12	**SIVANATHAM**	**39**	**M**	**L**	**A2**	**5 DAYS**	**1 HR**	**1 YR**	**3 DEG**	**80**	**78**	**EXCELLENT**	**-**	**RTA**
13	**PRABHU**	**37**	**M**	**L**	**A3**	**5 DAYS**	**50 MIN**	**1 YR**	**0 DEG**	**100**	**90**	**EXCELLENT**	**-**	**RTA**
`14	**RAJKUMAR**	**37**	**M**	**L**	**A3**	**5 DAYS**	**5 MIN**	**1 YR**	**2 DEG**	**90**	**92**	**EXCELLENT**	**-**	**RTA**
15	VIGNESHWARAN	27	M	L	A3	5DAYS	55MINS	1YR 4MONTHS	NIL	100	90	EXCELLENT	**-**	**RTA**

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ETHICS COMMITTEE CERTIFICATE

Name of the Candidate	:	Dr.M.Kishore kumar
Course	:	PG in MS., Orthopedic
Period of Study	:	2016-2019
College	:	MADURAI MEDICAL COLLEGE
Research Topic	:	A study of analysis of functional outcome of internal fixation of fibula by closed tens nailing in addition to tibia in distal both bone leg fractures
Ethical Committee as on	:	21.11.2017

The Ethics Committee, Madurai Medical College has decided to inform that your Research proposal is accepted.

Member Secretary Chairman Dean / Convenor

Prof Dr V Nagaraajan
M.D., MNAMS, D.M., Dsc.,(Neuro), Dsc (Hon)
CHAIRMAN
IEC - Madurai Medical College
Madurai

27 NOV 2017

DEAN
Madurai Medical College
Madurai-20

URKUND

Urkund Analysis Result

Analysed Document:	kishore thesis submission final.docx (D42508533)
Submitted:	10/13/2018 1:43:00 PM
Submitted By:	kishorek489@gmail.com
Significance:	2 %

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Instances where selected sources appear:

3